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THE INTERNATIONAL SUGAR·JOURNAL

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

Published at 7 & 8 Idol Lane, London, E.C.3

Vol. LXI
No. 725

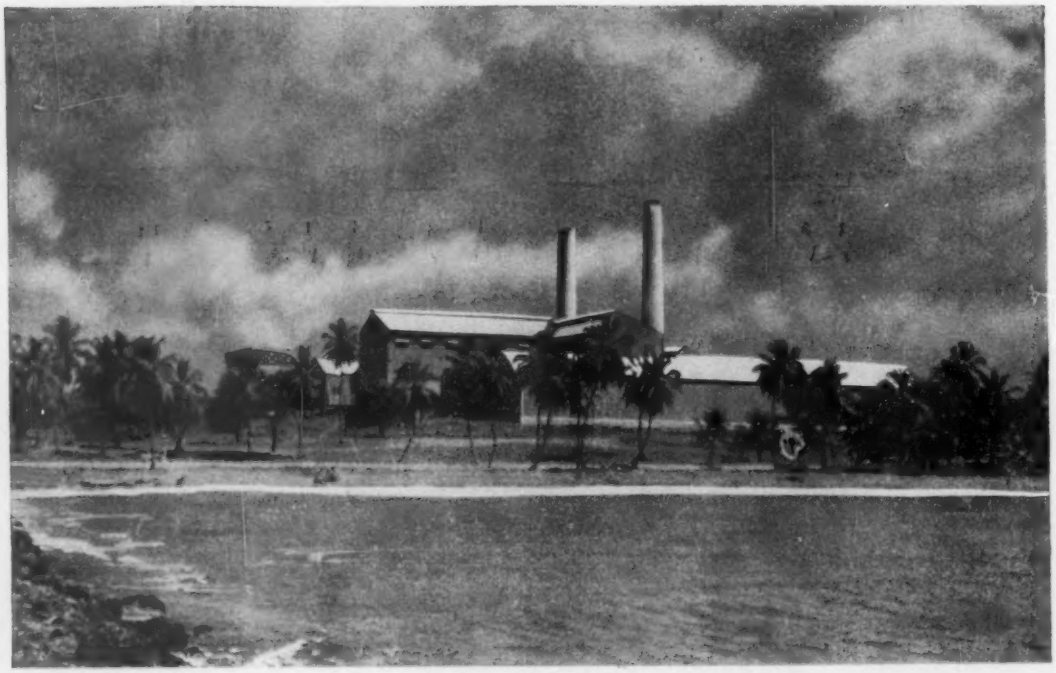
MAY, 1959

Pages
129—260

For LIST OF ADVERTISERS see page xl

FROM SUGAR CANE

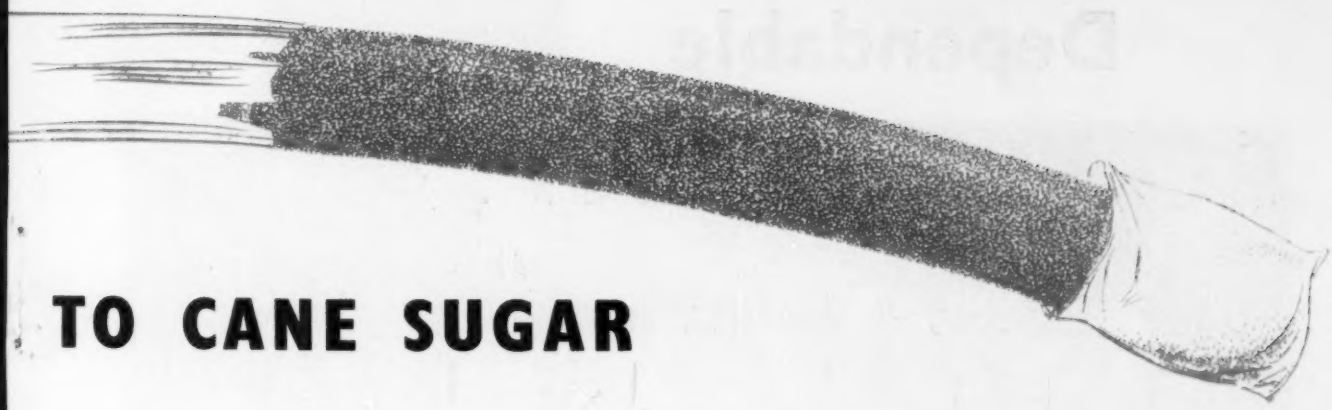
With 'Mirrlees'



Central Rio Haina in the Dominican Republic selected Mirrlees equipment to increase capacity from 6,500 to 13,000 tons cane per day. Last crop they ground 1,205,016 tons. They produce raw sugar.

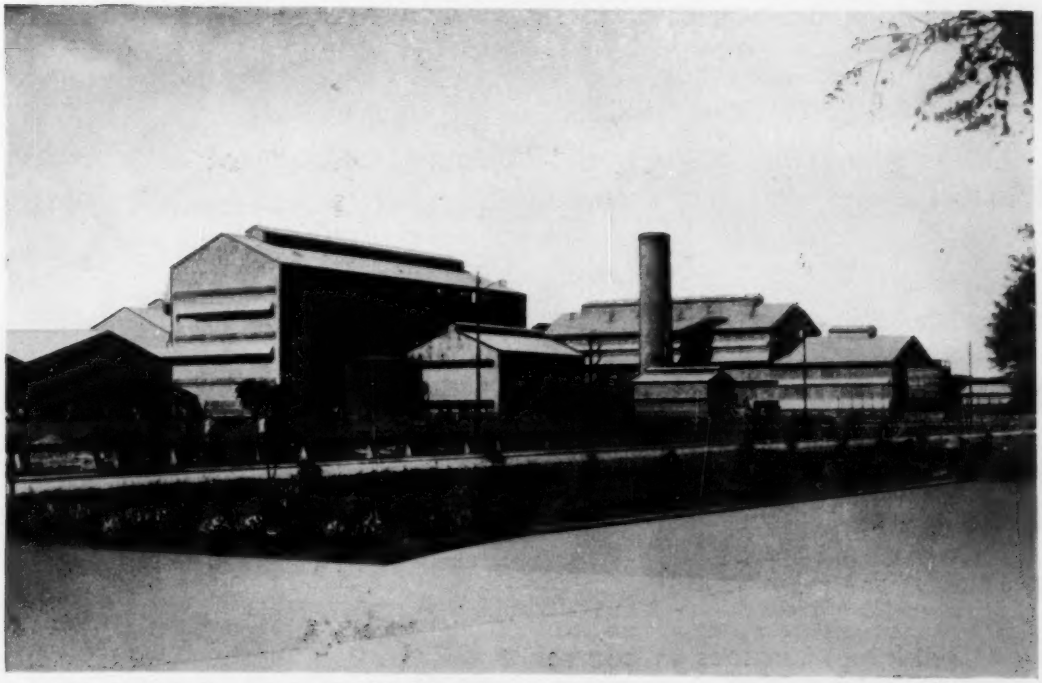
'Mirrlees'

We manufacture in our own works most of the equipment required in the production of Cane Sugar from Sugar Cane and welcome enquiries for particular items—or complete factories.



TO CANE SUGAR

Machinery



Central Rio Turbio in Venezuela installed Mirrlees equipment throughout. This factory grinds at the rate of 2,500 tons cane per day and produces refined sugar.

The MIRRLEES WATSON COMPANY LIMITED

Head Office and Works: SCOTLAND STREET, GLASGOW, C.5

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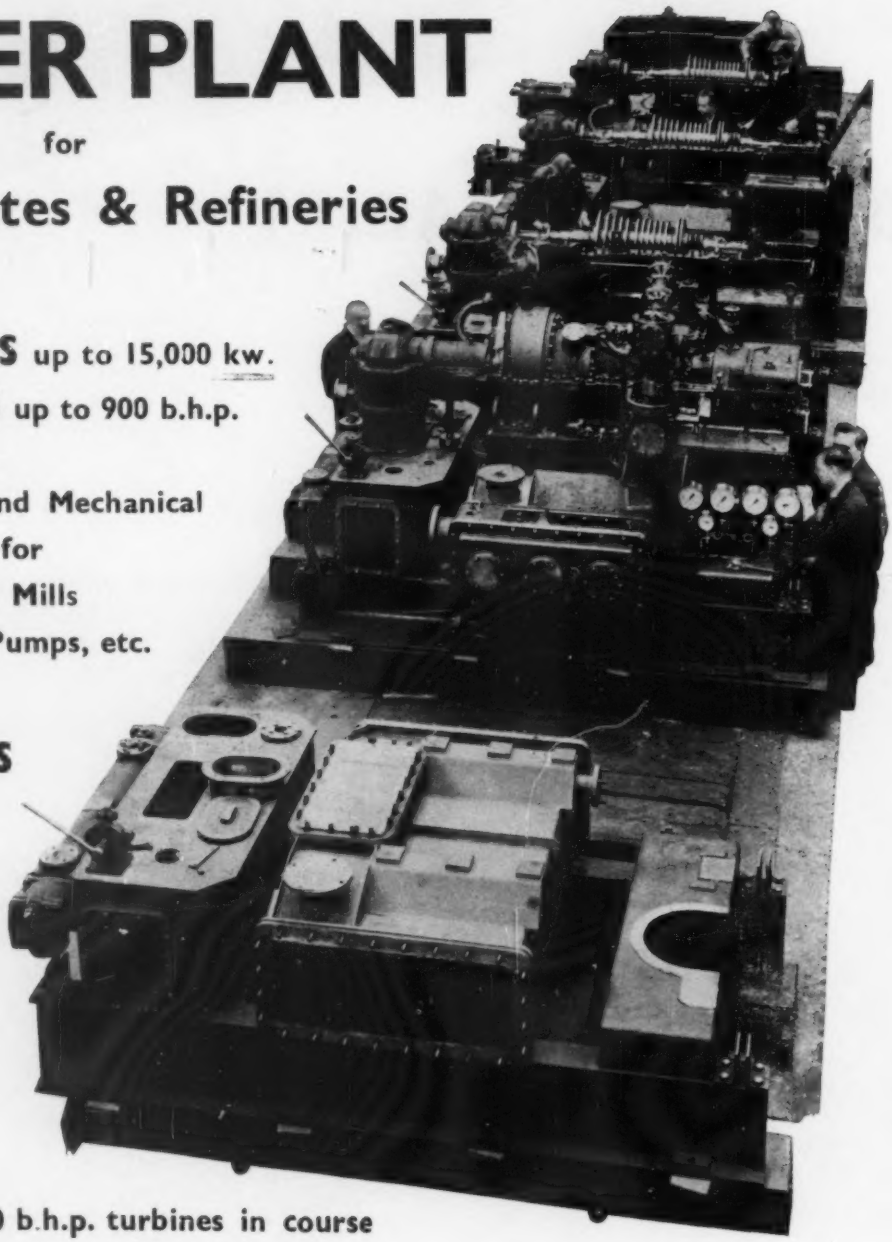

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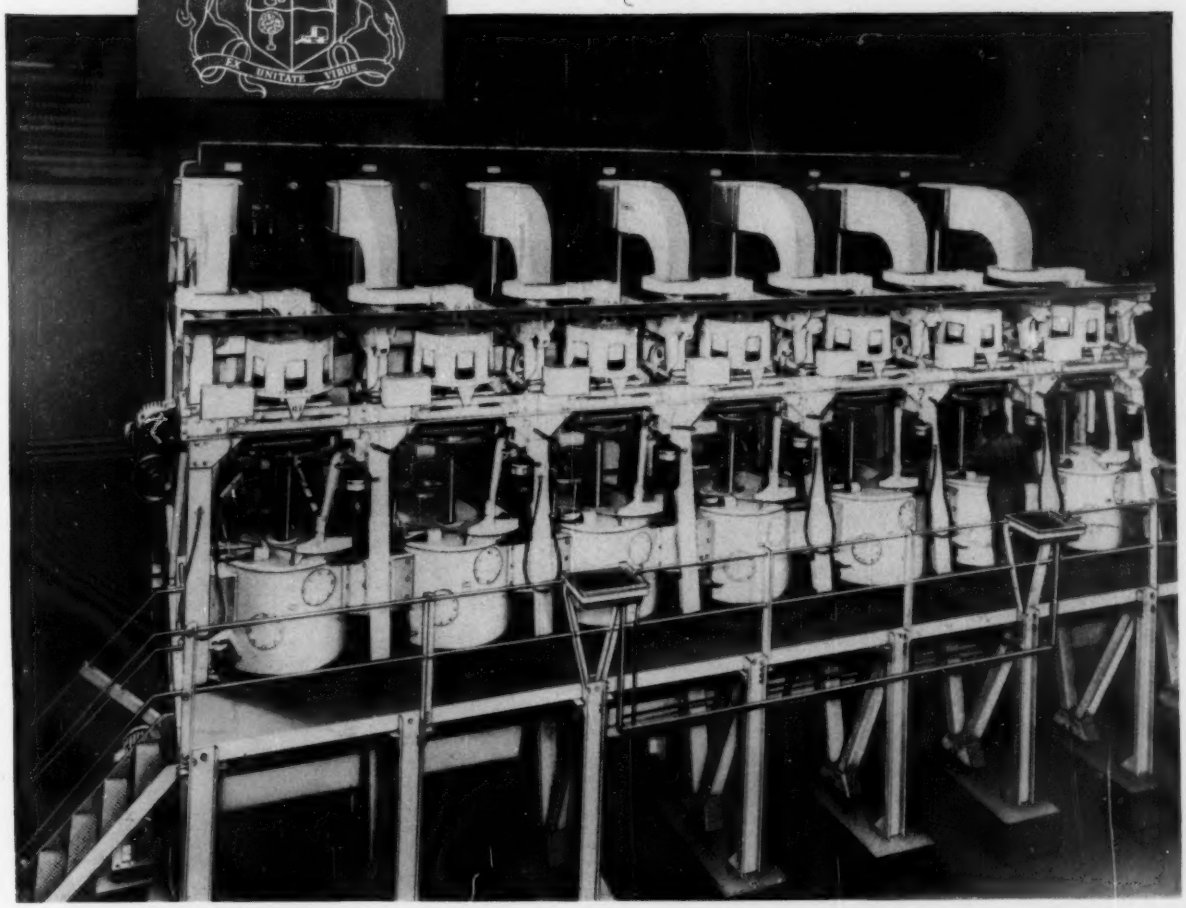

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the following factories installed Broadbent Centrifugals—

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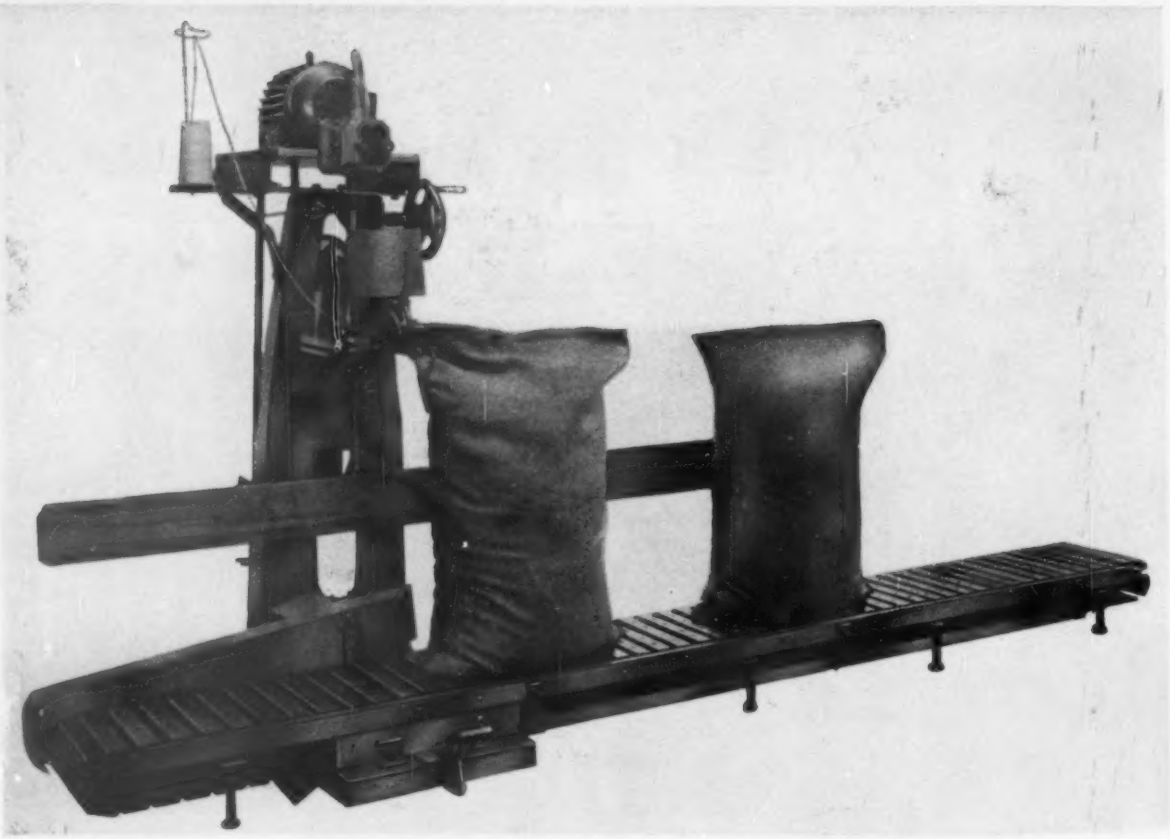

This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

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These instruments are also available with pneumatic transmission.

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OF
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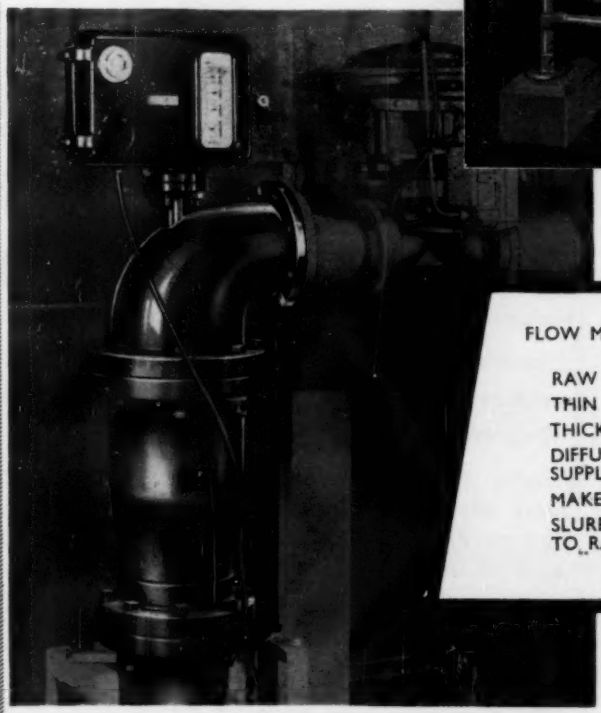
THICK JUICE
SLURRY RETURN
TO RAW JUICE



FLOW MEASUREMENT
OF
RAW JUICE
THIN JUICE
THICK JUICE
DIFFUSION
SUPPLY WATER
MAKE-UP WATER
SLURRY RETURN
TO RAW JUICE

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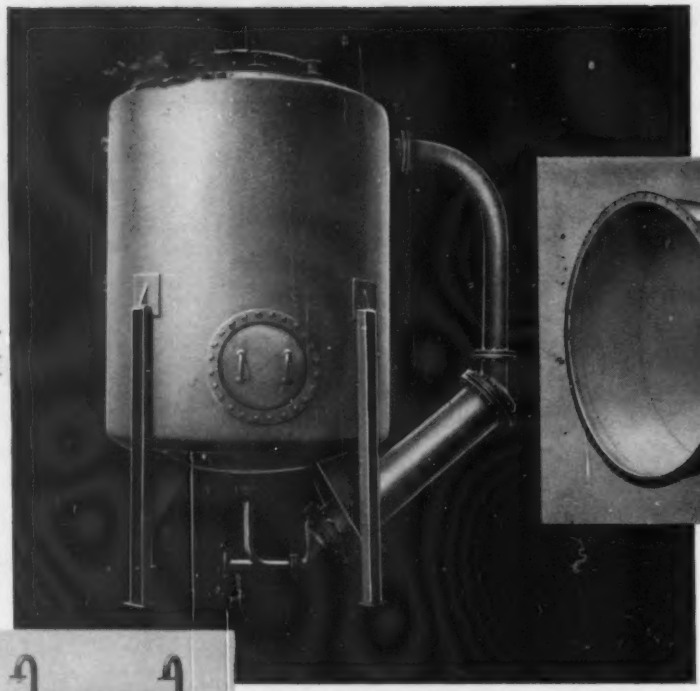
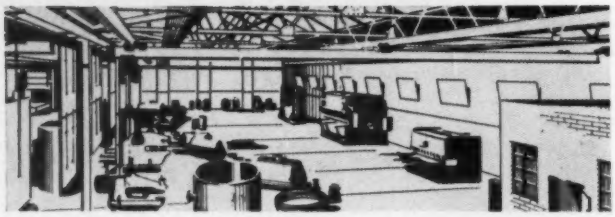


1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.

Stainless steel vessel with mild steel jacket

12,000 gallon water separator



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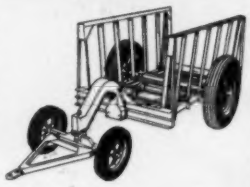
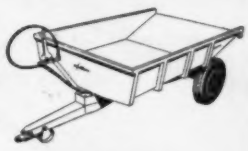


For constructional jobs, road making, etc., this 3-ton hydraulic tipping 'Dumper' trailer is a winner; very strongly made, it will give years of service under the most arduous conditions.



For speedy, economical handling of cane, Markham's Cane Trailers are unsurpassed. They will work easily over rugged terrain, and their exceptional strength of construction ensures a long, trouble-free life.

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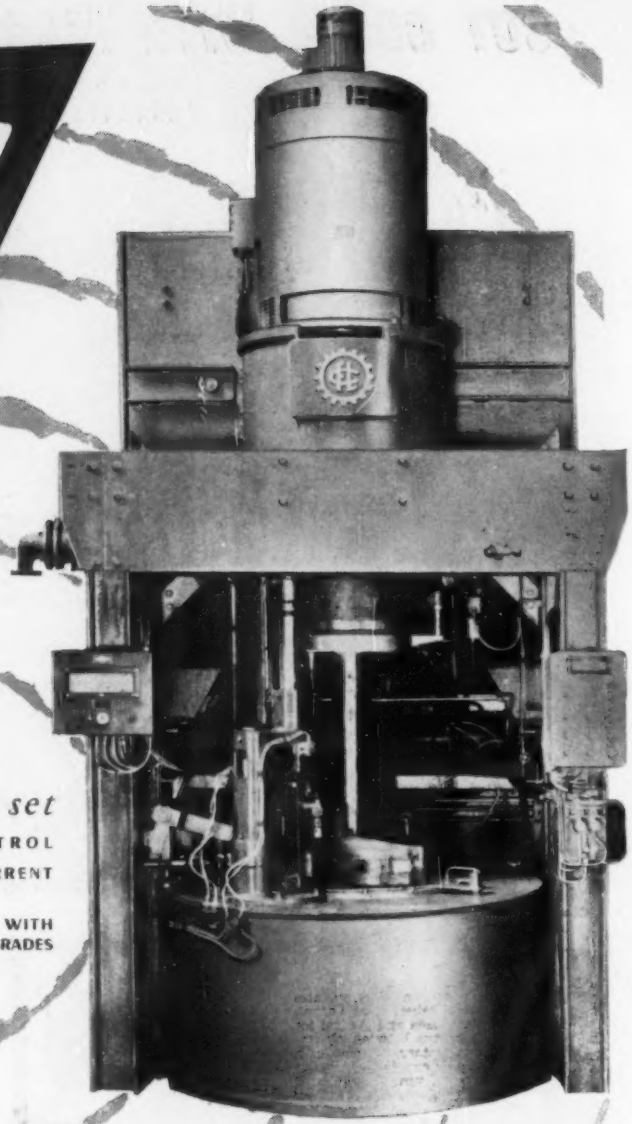

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Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)

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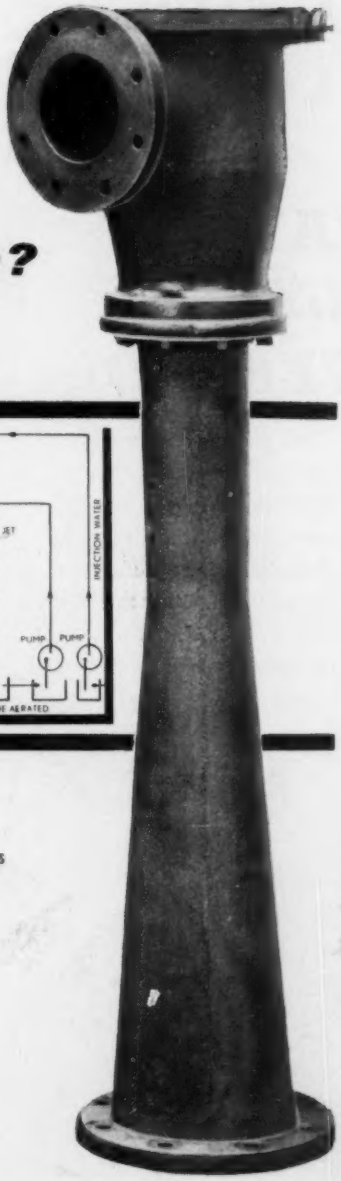
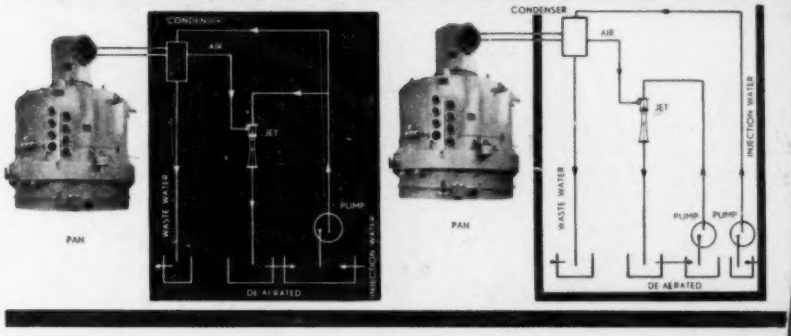
why not fall in line?



SCHEMATICAL ARRANGEMENTS



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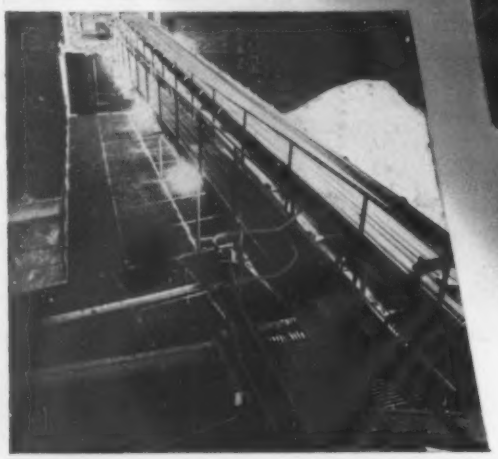
Safe foothold is assured in Tate & Lyle's Liverpool refinery by GRILL FLOOR flooring. Its open, non-slip surface sheds liquids, is easily cleaned and does not harbour dirt. On the stairways GRILL FLOOR stair treads and handrailing provide a sure footing



GRILL FLOOR stair treads at Tate & Lyle's Liverpool refinery.

Tate & Lyle's Liverpool refinery, flooring and handrailing by GRILL FLOORS

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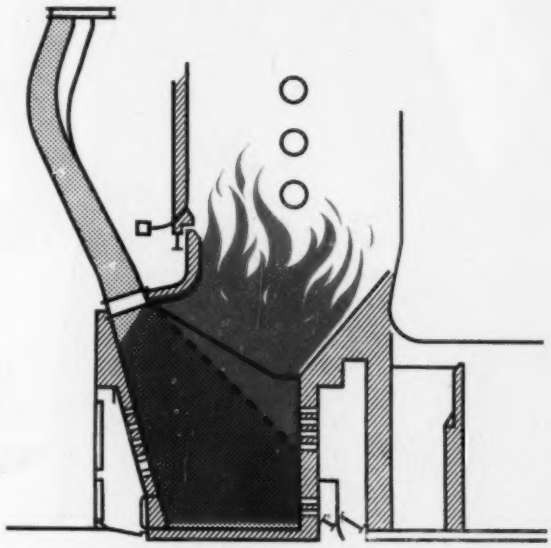
THOMPSON - EISNER FURNACES
AT THE
INGENIO CONCEPCION SUGAR MILL



● Simplicity. ● Economy of operation.
● Ample fuel reserve. ● Rapid response
● Ash problem minimised.

Thompson-Eisner furnaces are operating most successfully at Rio Turbio, Venezuela, with boilers of 108,000 lb/hr evaporation. However, the new installation at the Ingenio Concepcion sugar mill in Argentina is even larger. To date, this is the largest unit fitted with Thompson-Eisner furnaces. As a result of its special advantages the Thompson-Eisner furnace was chosen in preference to the other types of bagasse furnace. In particular it has an ample fuel reserve to allow for continued operation up to twenty minutes should there be any failure in the supply of fuel. Simplicity of design and the absence of mechanical throwers and firebars keep maintenance at a minimum.
Three Thompson-Eisner furnaces are fitted at Ingenio Concepcion sugar mill. Firing bagasse with a 50% moisture content, the boilers produce 132,000 lb/hr saturated steam at 300 p.s.i.

These furnaces are being built under licence from John Thompson by Sociedad Caren.

Among many users of Thompson-Eisner Furnaces

Above : Long Pond Factory.

Below : Jauharabad Sugar Factory, Pakistan.

Above : Kiranpur Sugar Factory, India.

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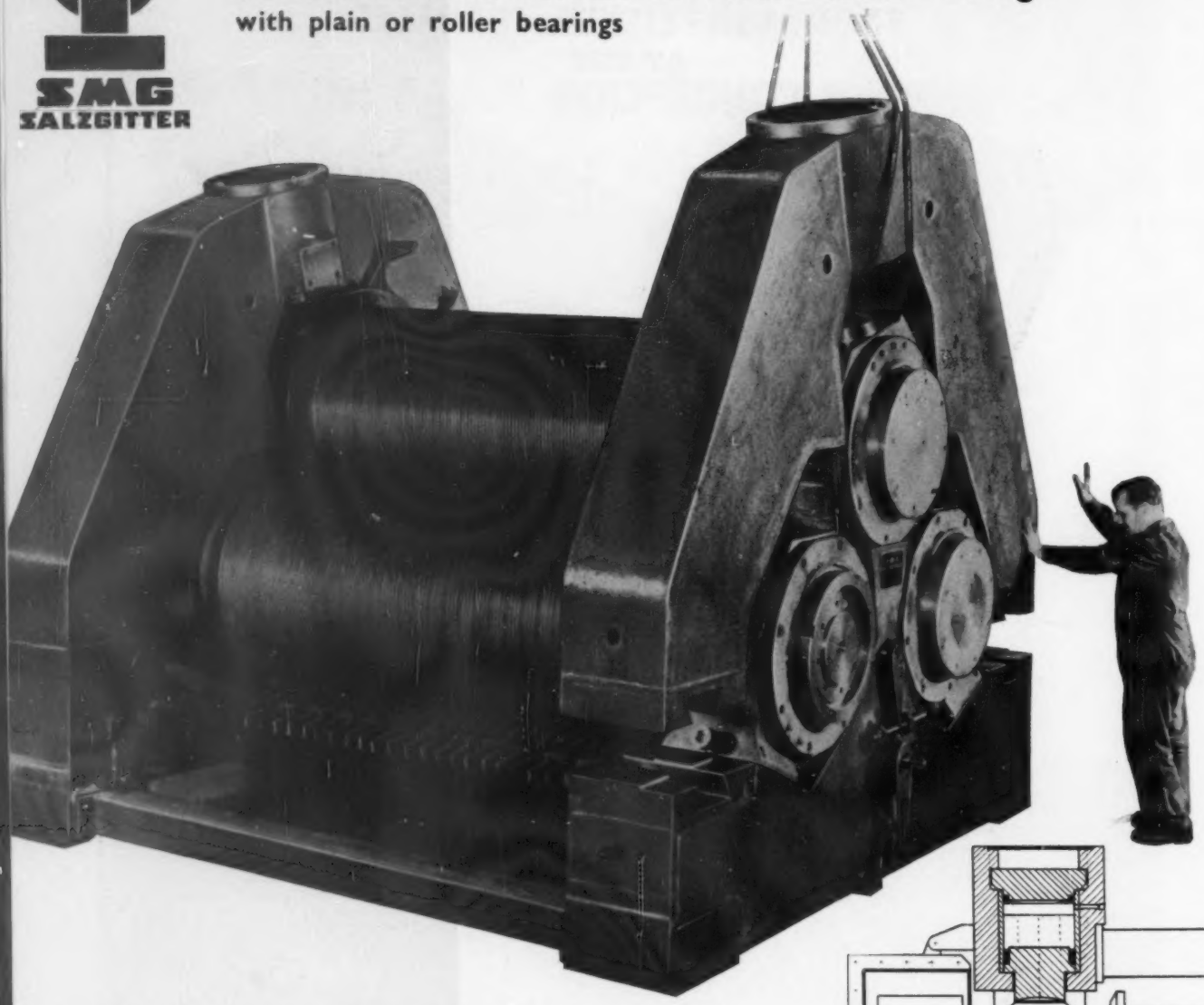

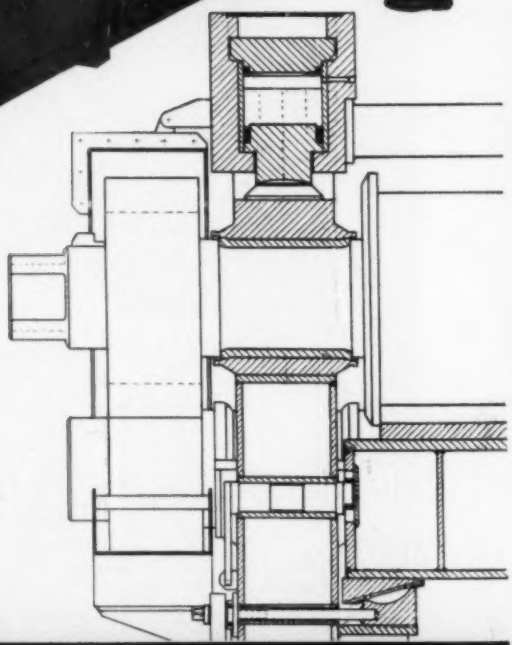

- **The two part mill headstocks can be quickly connected and disconnected by means of a keyed joint.**
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- **Bagasse bridge with trash plate adjustments arranged outside headstocks**
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class chain

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Link frames—available in malleable iron, Promal, bronze or stainless steel—can be furnished with pins and bushings of either carbon steel, bronze or stainless steel.

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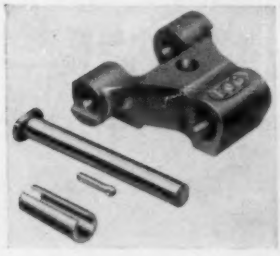
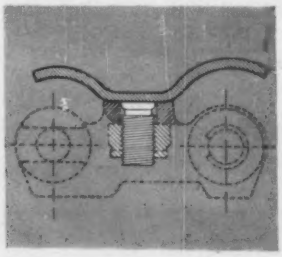
COMPONENTS are accurately made, carefully assembled. Wearing shoes at open end of link prevent tilting. Bushings are renewable, fit securely in barrel. Pins are firmly locked to prevent rotation in sidebar—cotter type assures easy assembly.

WELDED STUD SLATS eliminate slat hole elongation, prevent juice leakage and resist corrosion. Longer carrier life is assured because slats and chains are properly matched. Stainless steel self-locking nuts remain tight . . . make assembly and disassembly easy.





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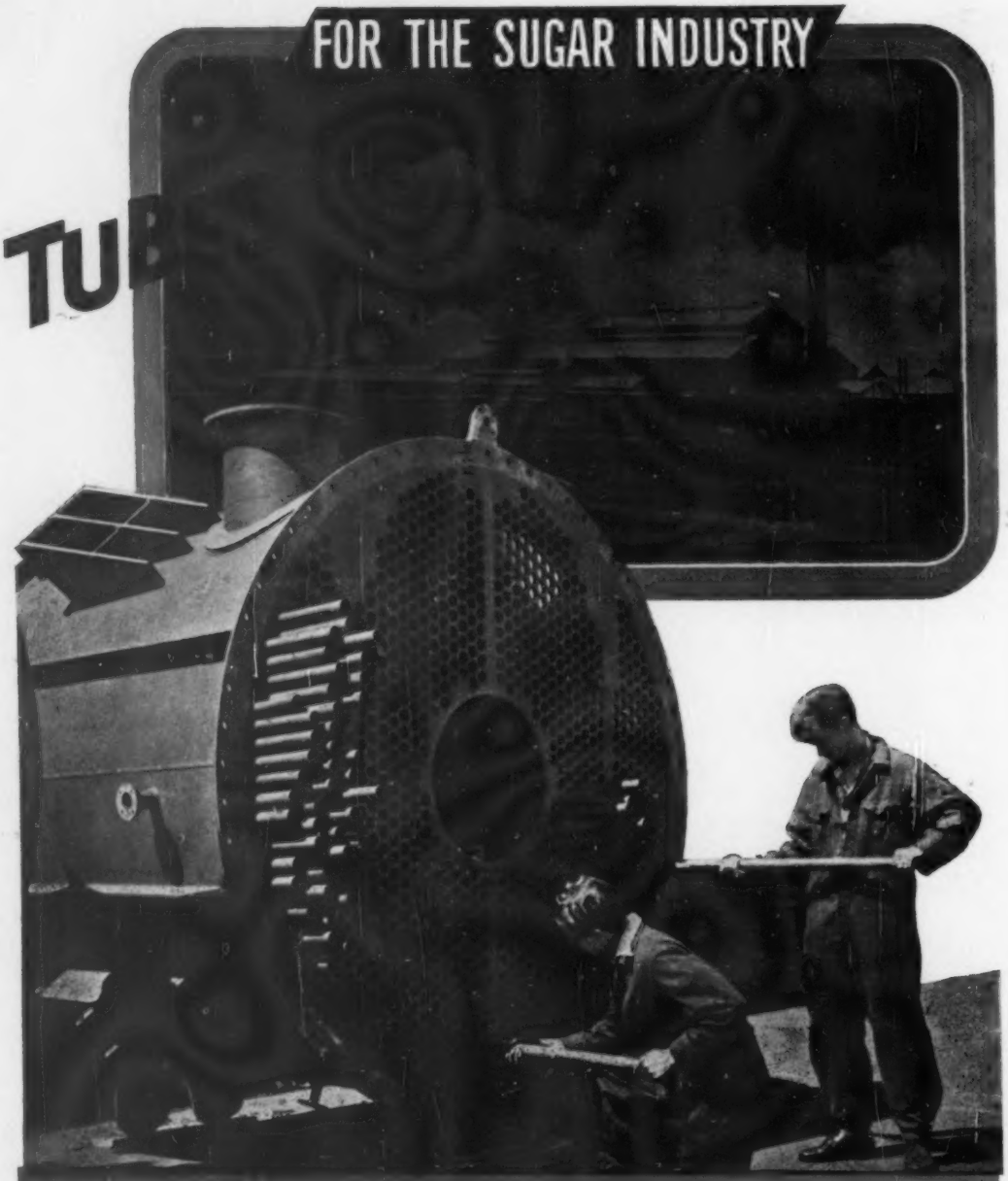

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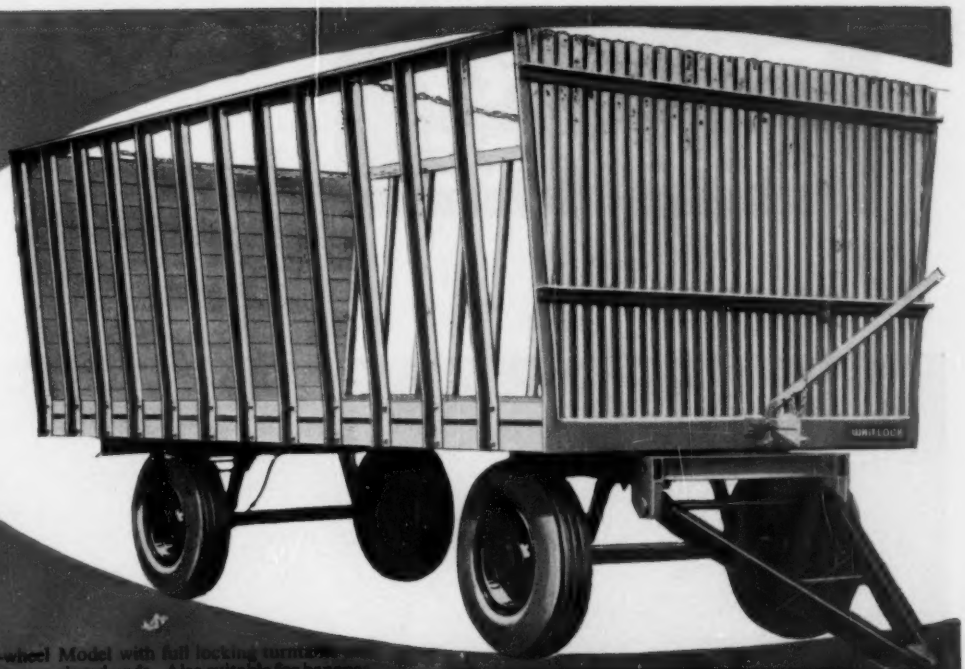
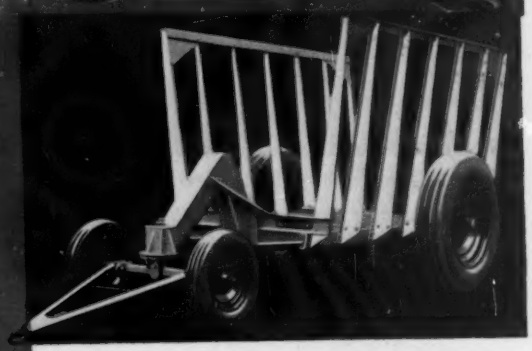


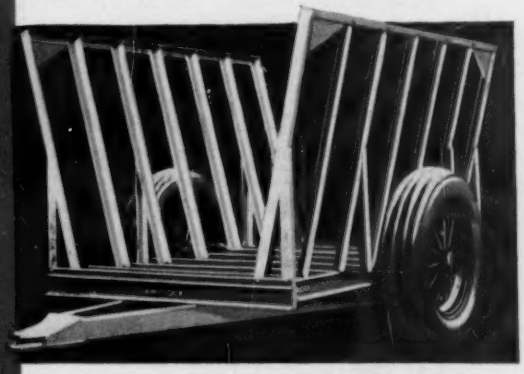
4-wheel Model with full locking turntable, open or closed ends. Also suitable for bananas. In various carrying capacities.

Cut cartage costs with

WHITLOCK CANE & FRUIT TRAILERS



4-wheel Goose-Neck type of pressed steel construction with extra heavy bracing for loads up to 6 tons.



A low cost model on large diameter wheels for loads up to 5 tons.

Our factory representatives are at the moment travelling the cane growing areas and may be visiting you personally.

Whitlock Cane Trailers are backed by many years experience and will stand-up to the job.

Ask for catalogue SC.41 and send details of your requirements.

WHITLOCK BROS LTD. GREAT YELDHAM ESSEX ENGLAND Tel: Great Yeldham 305 (8 lines)

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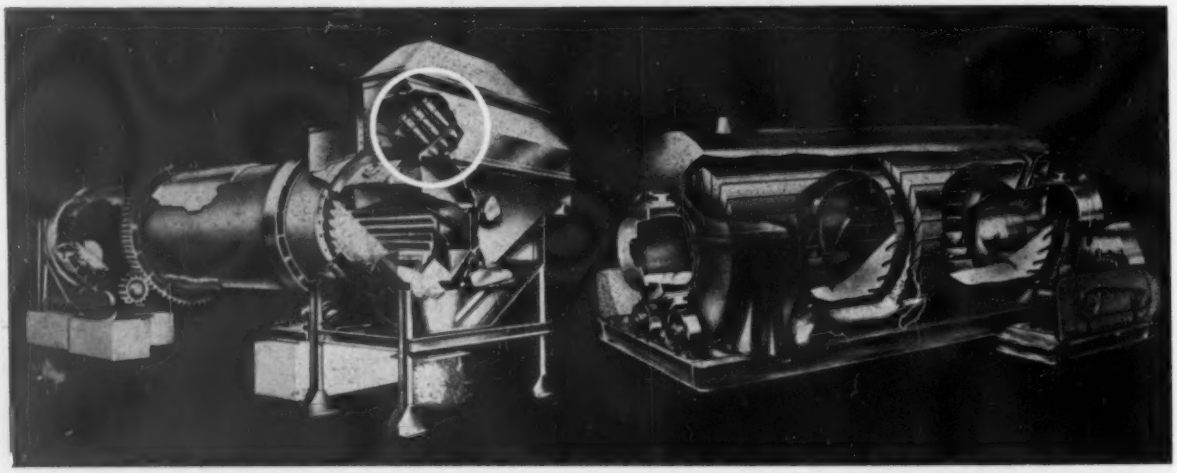
Roasters
Coolers

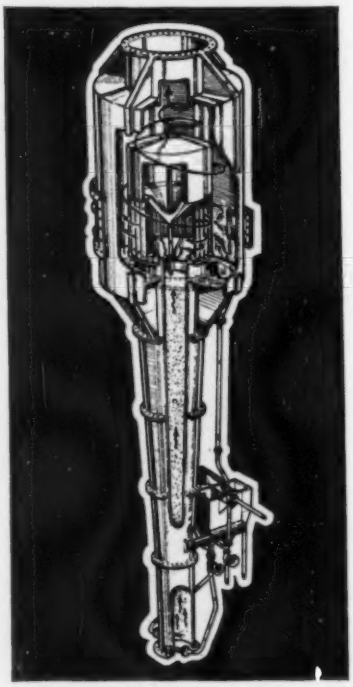


The well known Rotary Louvre Dryer

The new Rotary Water Louvre Cooler

A product is only as good as the equipment processing it. Our range of Dryers and Coolers is constructed to standards of precision and finish that ensure the highest degree of control, consistency and absolute reliability. Rotary Louvre equipment fulfils the requirements of Sugar Refineries when drying and cooling sugar either for filling into paper sacks or for bulk storage.

The latest addition to our range—the ROTARY WATER LOUVRE COOLER is of the staged and indirect type, using water as the coolant. The Dryers and Coolers are used by most of the biggest names in industry, and could make a major contribution to the efficiency of your plant.



THERMIX Dust Control & Collection Equipment for Sugar Refineries

The AIRMIX Wet De-duster illustrated is specially recommended for the collection of sugar dust created in the handling of sugar. Control of the dust as it is produced by positioning suction points and hoods on Elevators, Screens, Conveyors etc. enables it to be collected at a central point by an AIRMIX unit. Collection efficiencies of 99·8 per cent can be obtained, and the sugar solution in the washer is continuously recycled before passing to remelt.

The THERMIX range also includes TUBIX (Multi-tubular) Dust Collectors : BAG FILTERS : CYCLONES : DISCHARGE VALVES, etc.

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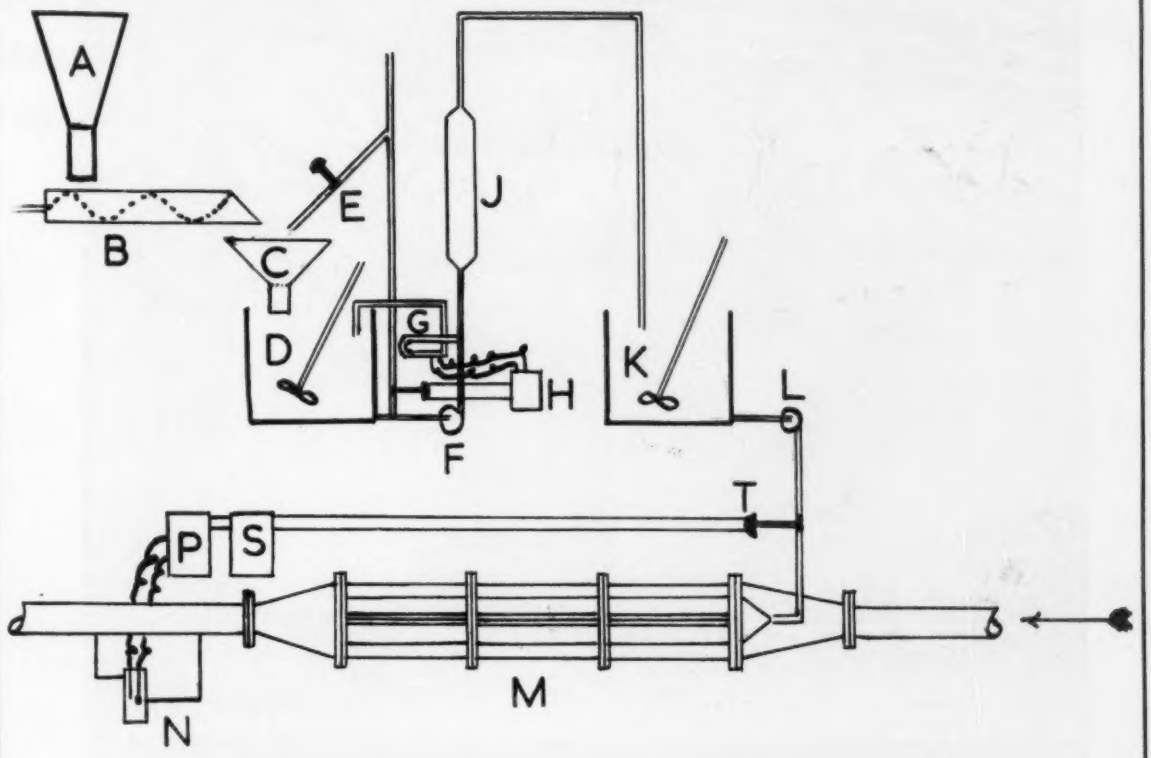

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* See *I.S.J.*, 1958, **60**, 213.

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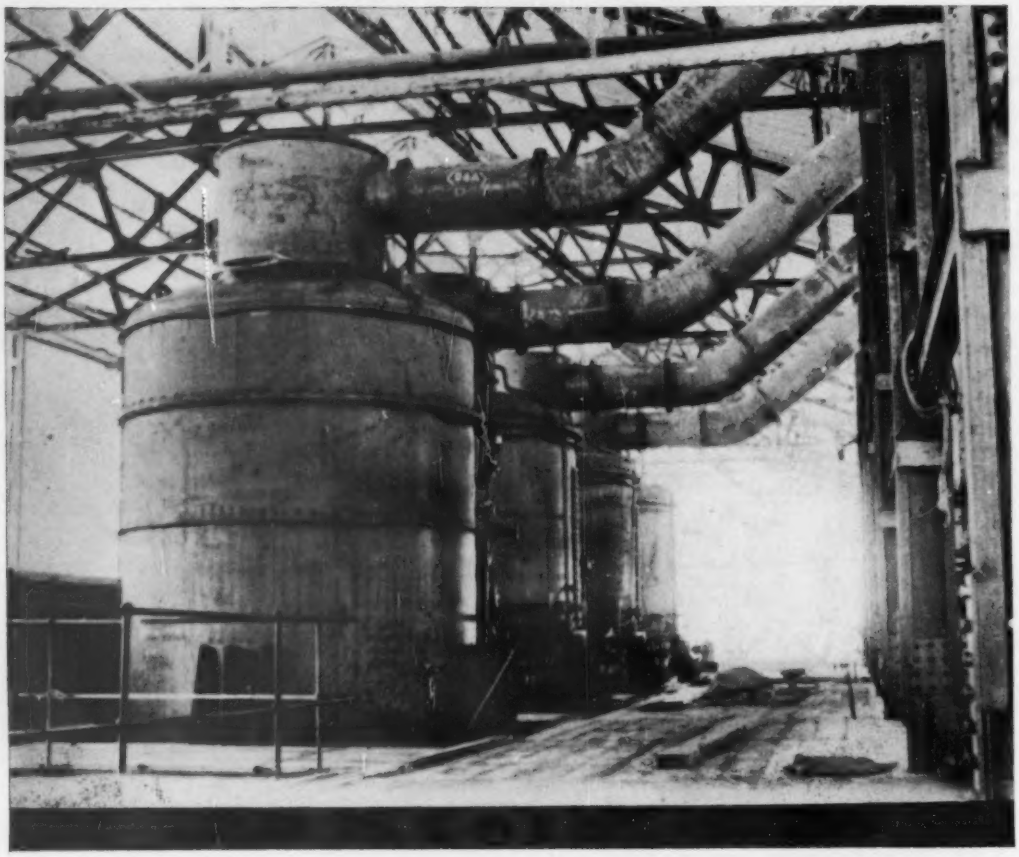

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International Sugar Journal

VOL. 61 *May 1959* No. 725

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Published by :
The International Sugar Journal Ltd.
7 & 8, Idol Lane, London, E.C.3.
Telephone : MANsion House 6822.
Cable : Sugaphilos, London.

Annual Subscription: 32s 0d or $5.00 post free
Single Copies: 2s 6d or 45 cents post free

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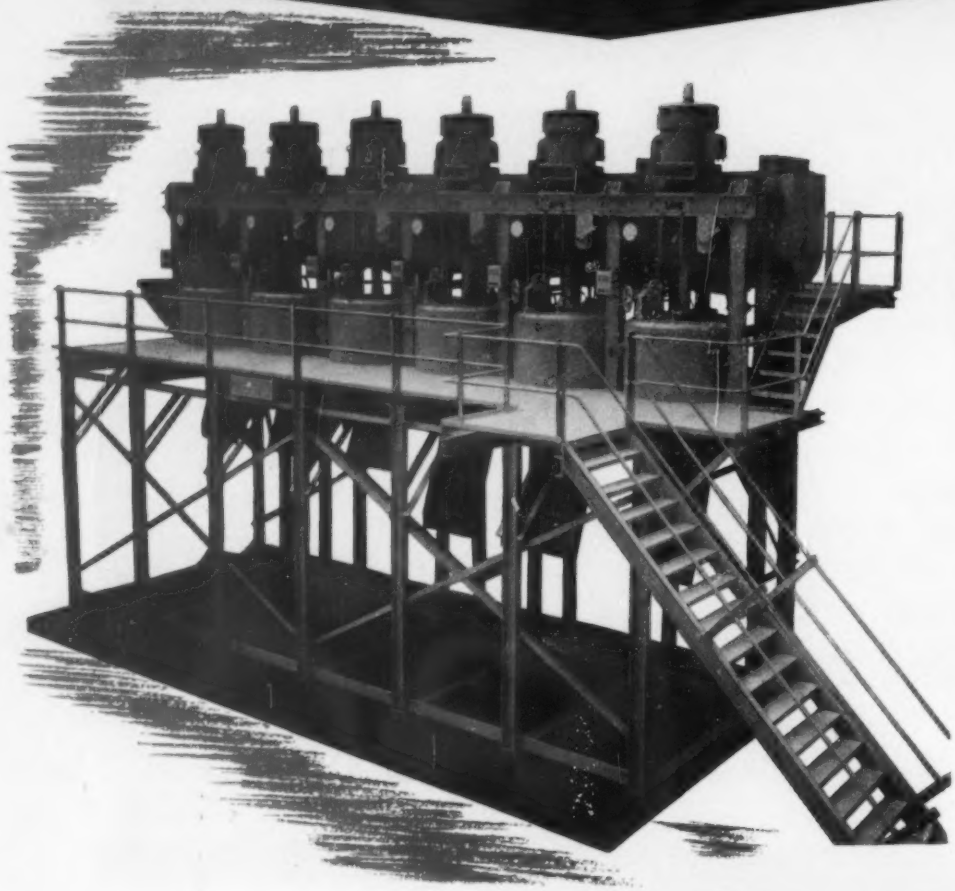

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VOL. LXI MAY, 1959 No. 725

NOTES AND COMMENTS

U.K. 1958-59 Campaign Results[1].

With a total yield of 5,742,016 tons, representing an average of 13·88 tons per acre, the 1958-59 sugar beet crop was 466,000 tons ahead of the previous record, in 1953-54. The tonnage delivered was 1,202,516 tons more than in the previous season, when the crop was seriously affected by virus yellows.

Spalding factory, with an average of 16¼ tons per acre, experienced the highest yield, and factory averages in excess of 15 tons per acre were attained by Cantley, Ely, Ipswich, King's Lynn and Wissington growers. Many individual crops of 23-25 tons per acre were recorded.

Production of sugar beet pulp—410,000 tons—was also the highest on record. Twenty thousand tons of pulp pellets were made at Bardney and King's Lynn factories, and for the first time a proportion was reserved for the feeding-stuffs trade, by whom the product was well received.

Due to the wet and sunless summer, sugar content averaged only 15·08%, and total sugar production, at 716,000 tons, was some 2,000 tons short of the record.

Conditions during the harvesting period were unfavourable, particularly towards the end, and rain, snow, hail and frost were all experienced during January. Growers and hauliers nevertheless succeeded in keeping all the factories operating at full capacity throughout the period. Two-thirds of the total tonnage is understood to have been harvested by machine.

Weather in the early autumn, which resulted in a late cereal harvest, also had its effect on the beet campaign, which started several days later than has been the case in recent years.

It is difficult to attribute the record crop to a single cause, but among the factors involved were: ideal seedbeds in the spring of 1958, rain that kept down the aphids so there was less virus, more spraying by farmers as an insurance against virus yellows disease, extra rain that gave high root weights, and a mild autumn which allowed an extended growing period.

Also, many of the fields which had earlier been reported as waterlogged and had been all but written off succeeded in making a remarkable recovery.

Sugar in the Central African Federation[2].

At present the Federation of Rhodesia and Nyasaland produces only 10% of her sugar requirements. However, the construction of the Kyle Dam and the proposed Bangala Dam in Southern Rhodesia has led to an upsurge of interest in production, and the position in the various sugar growing areas is as follows:—

Chirundu Sugar Estates.—Only 750 tons of sugar were produced during 1958 as a serious fire burnt out most of the crop. There are reported to be 1000 acres of newly established cane, and there are plans to expand to 3000 acres by 1960. Further expansion is apparently limited by lack of power to pump water. However, work on the 75-mile power line which will carry electricity from Lusaka to Chirundu is well ahead, and is scheduled for completion at the end of June.

Triangle Sugar Estates.—Last year 5000 tons of sugar were produced from 1600 acres, and it is hoped to produce 10–11,000 tons during the current year. At present there are reported to be about 4000 acres of cane in the fields. An experimental overhead irrigation scheme costing £325,000 has been installed, and about four-fifths of water to be drawn from the Kyle Dam (now under construction) will go to Triangle. It appears that the estates may have up to 20,000 acres under irrigation by 1965. Assuming a yield of 3½ tons of sugar per acre, this would mean a total production of 60–65,000 tons by 1965.

Hippo Valley Estates.—It is hoped to have 2000 acres under sugar cane by 1962, and 3000 acres the following year. Assuming an average yield of 3 tons per acre, total production by 1965 could thus be 9000 tons. It has been reported that the sugar acreage might be increased to 10,000 when water from Bangala and other projects becomes available.

Other bodies have also been showing interest in sugar growing, although plans are generally speculative and little advanced as yet. It is understood that the Elephant Marsh area in the Shire Valley of Nyasaland is well suited to cane production. The opinion has been expressed that although the Federation will be self-sufficient in its own refined sugar

[1] *British Sugar Beet Review*, 1959, **27**, 108.
[2] *Overseas Review* (Barclays D.C.O.), March 1959, 26.

(with refineries in Bulawayo, Salisbury and one being erected in Ndola) it will be a long time before sufficient sugar cane can be grown to meet the rapidly expanding consumption, far less to produce any exportable surplus.

* * *

Cuban Production and the Sugar Market.

Prices have declined steadily over the past month or two, with a fall of 1s 10½d per cwt, c.i.f., on the London market during the last month. Sugar is thus at the lowest market level since 1944 when for three years running the Cuban crop had been purchased at a price of 2·65 cents f.a.s.

C Czarnikow Ltd.[3] write: "The absence of any intimation from the Cuban Government as to her sugar policy is not calculated to bring confidence to the market. Reference by Premier CASTRO in early April to the fact that the current low prices are due to the heavy sugar output in Europe and that this expansion had been encouraged by the restriction of Cuban production over the years has been commented upon in market circles.

"In the meantime production in the Island is in full swing and contrary to the fears expressed in some quarters there was a full resumption of milling after the Easter holiday. Production up to the end of March, at 3,009,949 Spanish tons, was 945,000 tons behind last year's total for the same period but it is of interest to note that output during the second half of March was only 142,000 tons behind the comparable figure for 1958 despite the fact that this year the Easter week-end occurred during the period.

"Well informed circles continue to express the belief that the full decreed crop of 5·8 million tons will be produced but there must still be an element of doubt about this in view of the uncertainty as to the commencement of the rainy season. There has so far been no suggestion that mills finishing their quotas early should continue to grind, although authority has been given to some mills, whose production last year was hampered by revolutionary activities, to grind all the cane available even if quotas are exceeded. This is expected to involve about 15,000 tons.

* * *

Mauritius Sugar Production in 1958[4].

The final results for the 1958 crop show a production of 4,329,013 metric tons of cane yielding 525,654 metric tons of sugar. The average extraction percentage was 12·14. These figures compare with 4,343,824 metric tons of cane and 561,602 metric tons of sugar for the 1957 crop.

Up to 19th January, 446,239 metric tons of the 1958 crop had been shipped to the following destinations :—

United Kingdom 357,972 ; Canada 51,745 ; Morocco 10,148 ; Lebanon 9,331 ; Iran 8,966 ; Malaya 3,920; Singapore 2,134 ; Hong Kong 1,270 ; and Seychelles 753 metric tons.

This total compares with 469,626 metric tons for the corresponding period a year earlier. During the calendar year 1958 Mauritius exported 522,752 metric tons of sugar (partly 1957 and partly 1958 crop) and about 25,000 metric tons were consumed locally. In 1957 sugar exports totalled 579,353 metric tons.

The Cyclone and Drought Insurance Board has approved that the year 1958 should be declared a "cyclone year" in respect of 15 factory areas out of the 25 factories which were in operation last year and compensation will accordingly be payable to planters of those areas.

* * *

Tate & Lyle Investments Limited—Annual Report, 1958

Raw Sugar Production

The 1958 crop in Trinidad proved successful for Ste. Madeleine, but was a difficult one for Caroni in spite of an increased tonnage. Adverse weather conditions affected the yield of sugar from the cane and although 8 per cent more sugar was produced, 27 per cent more cane had to be milled. This resulted in considerably increased costs and in addition there was a substantial wage increase during the year.

In Jamaica, output fell below the figure for previous years primarily owing to the disturbance of the agricultural cycle, which partly accounted for the somewhat disappointing results.

Every effort has been made to establish under cane the 3,000 acres of land at Chirundu in Southern Rhodesia, but this has taken longer than anticipated, and full production will be delayed for a further year. The overhead irrigation system has been completed over the area and arrangements have been made for the erection of a power line to enable all the power requirements of the estate to be supplied by the Lusaka Electricity Supply Corporation Limited.

Refined Sugar Production

John Walker & Co. (Sugar Refiners) Ltd. have had a successful year and their results are beginning to show the effect of savings in operating costs from refinery reorganisation and from capital expenditure on new plant. The Greenock refineries are now supplied with bulk raw sugar from the new terminal at James Watt Dock, operated by the Greenock Bulk Handling Co. Ltd.

The Group has a substantial holding in Canada & Dominion Sugar Co. Ltd., who have recently erected a refinery at Toronto. It has been designed to take advantage of the opportunities offered by the newly constructed St. Lawrence Seaway, and will be capable of producing somewhere in the region of 260,000 tons per annum.

The erection of a new refinery in Ndola in the Northern Rhodesia Copperbelt is proceeding and it should come into production early in 1960. The refinery will serve a consuming area which has hitherto had to rely on supplies from the Rhodesia Sugar Company's Bulawayo Refinery involving a very long and costly haul by rail.

[3] *Sugar Review*, 1959, (400), 63.
[4] *Overseas Review* (Barclays D.C. & O.), February 1959, p.27.

PRINCIPLES AND PRACTICE FOR THE CONTROL OF EELWORM DISEASES

By JOHN GRAINGER

(Department of Plant Pathology, West of Scotland Agricultural College, Auchincruive, Ayr, Scotland.)

(In the *I.S.J.*, 1958, **60**, 31, appeared an article by C. L. DUDDINGTON on the biological control of the eelworm. The present article describes methods of chemical control.—Ed.)

PART I

SUCCESSFUL control of any disease depends upon a knowledge of the behaviour of the parasite in relation to its host, and it is therefore necessary to consider first various factors of eelworm biology.

Biology of the eelworm

Members of the genus *Heterodera* produce their eggs within horny bags or cysts which are somewhat resistant to penetration by some treatments, and fortunately they do not seem to be important parasites of sugar cane. *Meloidogyne* species are known to attack sugar cane, and their eggs occur in gelatinous masses outside the body, where control treatment can reach them more readily than if they were in cysts. The kinds which are most easy of all to control are species of, say, *Ditylenchus* or *Pratylenchus*, the eggs of which are not specially protected.

The stem eelworm *Ditylenchus dipsaci* on many plants (e.g. oats) attacks its host only at the soil surface whilst cysts of *Heterodera rostochiensis*, the potato root eelworm, and organisms of the genus *Meloidogyne* are distributed through the whole soil mass. Control of true surface feeders is much less expensive than treatment of the soil in depth. When eelworms infest the soil mass, they are frequently found to a depth greater than that of cultivation. The deep infestations are probably of less account than those nearer the surface and though they may, and usually do, prevent an absolute 100% control, they do not prevent valuable economic increases in yield from treatment within the depth of cultivation.

Many eelworms persist in a potentially active condition in the soil for some years in the absence of a susceptible host crop. There is, however, always some wastage of the population, the rate of which is generally greater the higher the temperature, and the question of control by rotation naturally arises. Extending the rotation between two sugar cane crops could itself introduce economic loss, but might be necessary as an adjunct to treatment if infestations were very high (see below). The genus *Meloidogyne*, moreover, has a considerable host range, and so might other species likely to occur. Possible weed hosts must therefore be considered as a potential complicating factor in eelworm control.

Laboratory Estimates of Eelworm Populations

Successful control of eelworm diseases demands a closer liaison between advisory technologist and grower than does any other type of control known to plant pathology, and quantitative methods are required for estimating populations of eelworms in the soil and for measuring the intensity of attack on the roots[1, 2, 3, 4]. Control of new, slight, shallow infestations is far easier than that of old, heavy and deep ones, and early recognition is frequently the most vital factor in success. Moreover, the important matter in disease control is not how many organisms are destroyed by treatment, but how few are left. Methods of field control are frequently applied to eelworm populations which are so high that in spite of considerable reduction in numbers by treatment, those that remain are still capable of causing serious economic loss, and treatment then seems to have had little or no effect.

Relations of the eelworm population with yield are fundamentally of the type shown in fig. 1. When numbers are too few to bring maximum damage to the plant roots (the unshaded area) the yield bears a somewhat logarithmic relation to the magnitude of the actual population. Eelworms are, however, usually able to produce large numbers when a susceptible crop is grown, and frequently there are more eelworms than can cause maximum damage to the plant roots, but, no matter how many there are, within the shaded area of fig. 1, the yield has sunk to its lowest level, and cannot be depressed any further. The relative number of eelworms is, however, still most important in control. Lines *A* and *B* in fig. 1 both represent the same percentage diminution of the population by treatment, but the population left by *A* is still within the shaded area, and no increase in yield would result. Line *B*, on the other hand, represents a population reduced to a value well within the unshaded area, and a substantial increase in yield (*B'*) is obtained.

The population value represented by the junction of the shaded and unshaded areas of fig. 1 can be found by survey or experiment. If a population is so high that reduction by a given percentage treatment still leaves it within the shaded area, the infestation can only be reduced to a controllable level by the avoidance of a susceptible crop. It then becomes

[1] GOODEY : "Laboratory methods for work with plant soil nematodes". *Min. Agric. Fish. and Food Tech. Bull.* 1957, (2), 1–25.

[2] S'JACOB and STEMERDING : "Een handleiding voor Nematologie". *Plantenziektenkundige Dienst Overdruk*, 1956, (120), 1–107.

[3] MINDERMAN : "New techniques for counting and isolating free living nematodes from small soil samples and from oak forest litter". *Nematologica*, 1956, **1**, 216–226.

[4] SEINHORST : The quantitative extraction of nematodes from soil. *Nematologica*, 1956, **1**, 249–267.

necessary to know the rate of natural wastage mentioned above. Quantitative examples of the use of population measurements in practical control of the potato root eelworm are being published[5], and would serve as a guide for any further details of principle.

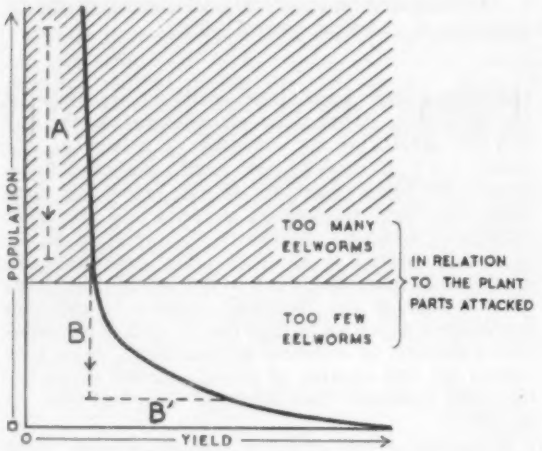

Fig. 1. The general relation between eelworm populations and yield. For explanation of *A*, *B* and *B'*, see text.

Hygiene and Management

Eelworm diseases are spread from place to place by the transport of diseased material, and, for those which persist in the soil mass, by any method which moves soil. International plant protection agreements and quarantine regulations are now adequate to prevent spread between nations, and there is, moreover, a growing tendency to wash earthy propagating material free from soil before it is distributed (e.g. seed potatoes). There is still need for great care within a country, to limit any outbreak of eelworm disease, for the best control is still the avoidance of an attack wherever possible. New planting material brought from another area should be grown in a quarantine plot and only if healthy should it be established in a main plantation. Borrowed machines should be washed free from soil ; we have found over 20,000 cysts of the potato root eelworm in the soil sticking to the four wheels of a tractor in wet weather. Visits on infested ground are to be deprecated ; we carried 27 root eelworm cysts away on our boots on one moist occasion. Should eelworm attack, early diagnosis and treatment is essential, as already mentioned, and if any eelworm-infested material can be burnt and not returned to the ground, so much the better.

Control of Eelworm on Plant Material

Dormant propagating material known to be eelworm infested can sometimes be freed from the parasite by treatment. Washing with a high-pressure water jet removes surface eelworms, e.g. root eelworm cysts from potato tubers, and a proportion of *Aphelenchoides ritzema-bosii* from chrysanthemum plants. The last-mentioned moves over the plant surface, and a useful degree of control has been obtained by spraying young plants twice with 0·005% "Parathion"[6]. Nemacidal dips containing mercury, and fumigation techniques have also been used with success against surface eelworms.

If eelworms are inside the plant material as are *Ditylenchus dipsaci* in bulbs, the only likely method of control is by hot water treatment[7]. The material is placed in water which is maintained at a given temperature for a given time, preferably with constant stirring, and then quickly cooled. Treatments at 110°F (43°C) for 20 to 25 minutes, or at 115°F (46°C) for 5 minutes are generally suitable for superficial *Aphelenchoides* on chrysanthemum, but even internal eelworms are not likely to survive the hot water treatment at 50°C for 1 to 1½ hours already applied in many regions for the control of the ratoon stunting virus of sugar cane. Living plant material, however, varies in its ability to survive this treatment.

Systems of Direct Field Control

At the end of the second world war there was scarcely any material known to be suitable for eelworm control. We now have four different systems and a fair number of suitable materials. One system is a surface treatment, but the other three can be applied in depth. Treatment of the whole soil mass, even to a depth of 9 inches, has been a difficult problem for the agricultural engineer, but has been overcome by two of the systems.

Soil mixing is the newest, least expensive and, in temperate climates, the most effective method. It has been developed solely at Auchincruive, where it was found that very small amounts of various mercury compounds mixed very intimately with the soil would control potato root eelworm far more efficiently than much larger amounts merely raked into the surface. Substitution of a radioactive compound for the mercury made it possible to specify quantitatively what is meant by intimate mixing—the added material must not vary outside the limits of plus or minus 20% of the required dose in all parts of the soil mass, except for a small tolerance within plus or minus 30%. If the dose is 5 lb per acre, the added material must not, at any point, be at less than a rate of 4 lb (80%) nor more than 6 lb (120%). This seemed a very tight specification, but radioactive isotopes were used further to assess the performance of various types of mixing device. The horizontal rotary cultivator emerged as the best mixer, but two placings of the added material were found absolutely necessary for an even mix in depth—one placing at or near the surface, and another well down towards the depth of rotary cultivation. Deep applications were mechanised by blowing dust into the spaces behind a suitable number of duck-foot tines. Applications

[5] GRAINGER : "Population studies and successful control of the potato root eelworm". 1959.

[6] BRYDEN and HODSON : "Control of chrysanthemum eelworm by Parathion". *Plant Pathology*, 1957, **6**, 20–24.

[7] ANON : "Hot water treatment of plants". *Min. Agric. Fish and Food Adv. Leaflet*, 1955, (379), 1–5.

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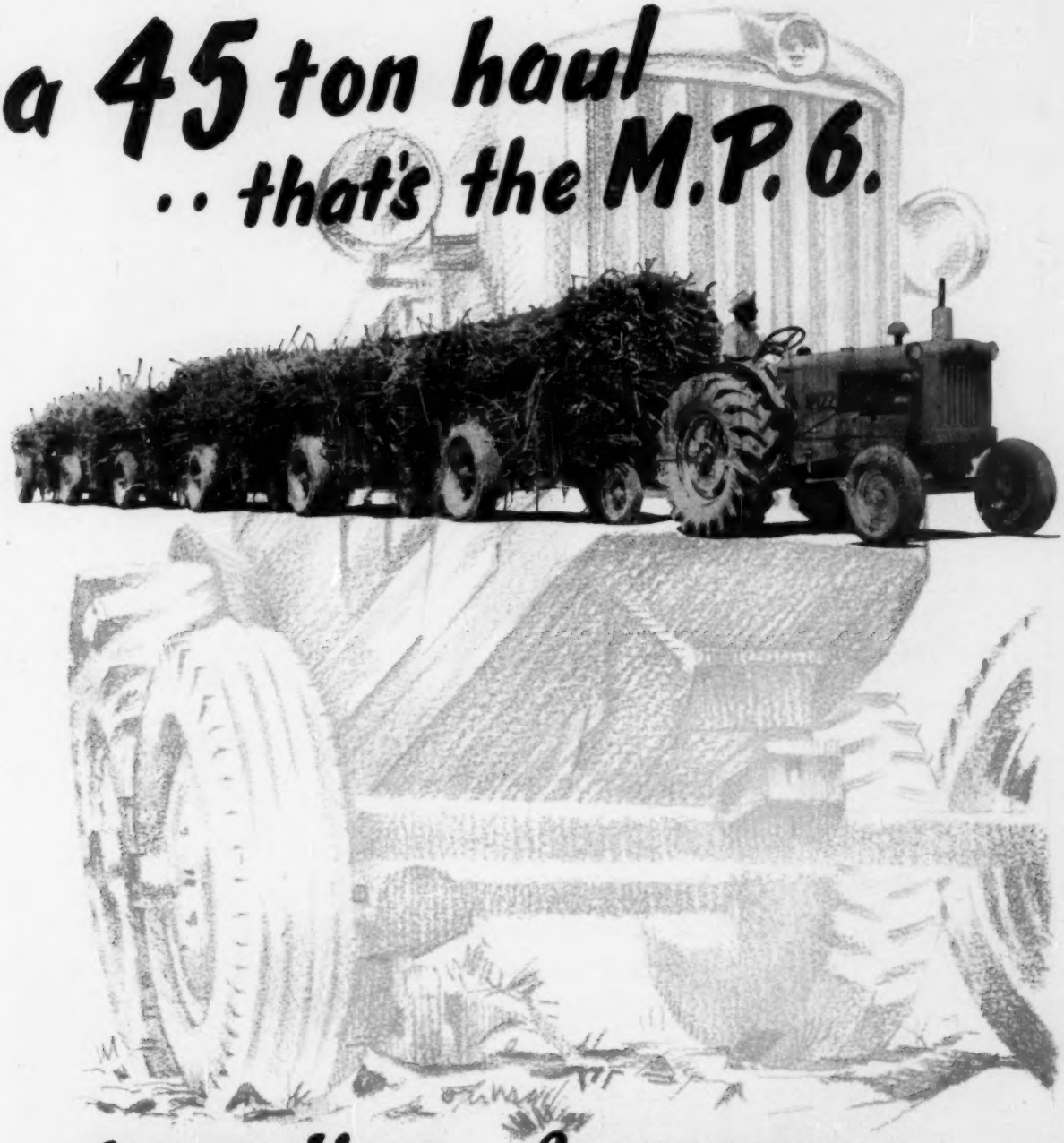

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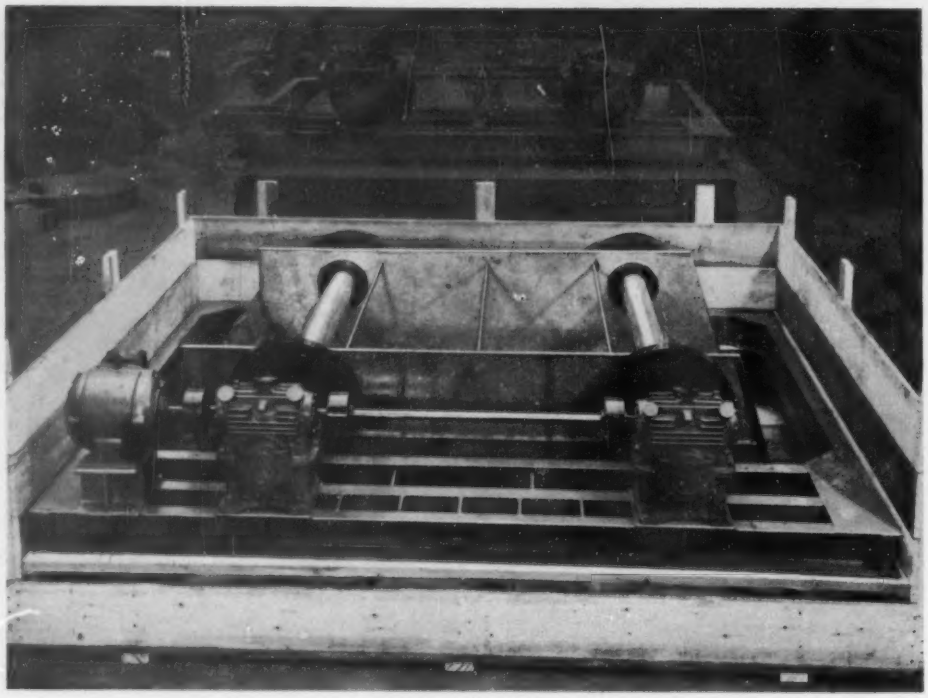

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at the surface and at 7 inches depth, rotary cultivated to 9 inches, gave a mix of the required specification through the whole mass (fig. 2). A prototype production machine* has now been made (fig. 3); it is rear-mounted on a diesel tractor, the diesel exhaust

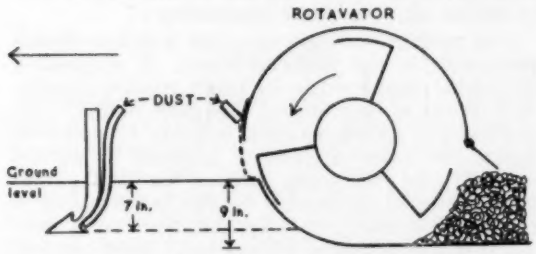

Fig. 2. General scheme of the soil disease control unit. Two placings of the dust (---) (1) behind duck-foot tines working at 7-in depth, and (2) on the surface, are mixed in by the rotary cultivator working to 9 in. This achieves a mix of the added material to within ±20% in all parts of the treated soil.

being used to pick up the dust, and the necessary power for driving the "Rotavator" and booster fan for the dust is taken from the standard rear p.t.o. Practically no dust escapes into the air when the machine is properly adjusted, and mercury compounds are quickly reduced to elemental Hg in the soil, so there is little chance of uptake by plants.

Fig. 3. The soil disease control unit mounted on a diesel tractor with exhaust control valve and flexible tube connected to the dusting arrangement.

The most economic dust† for this soil disease control unit is one of low volume weight (as lb per cubic foot) and something like 12 bushels (13·2 cu. ft.) per acre are required for adequate mixing to a depth of 9 inches. This volume contains 5 lb of mercury as yellow oxide equivalent (Y.O.M.). We have recently, however, obtained very good results against the potato root eelworm from treatment at half the rate, so the quantities just given may well be on the high side. It seems likely that the cost of material will be about £10 per acre for treatment 9 inches deep, and as the soil disease control unit also brings the necessary tilth, the cost of application is frequently balanced by savings on other cultivation operations.

The ground is first ploughed and allowed to weather. It is best to work the soil disease control unit across the ploughing, and treatment should not be given within six days of planting, to avoid any toxic action of Y.O.M. on the crop. The operation when correctly ordered should bring at least 75% diminution in the population of potato root eelworm which is able to attack the roots. This is the best percentage control so far known in this setting, and when treatment is given to populations of suitable level, the ratio of cost to benefit (the value of yield increase) is at least 1 to 4. The machine has been described in detail[§] and results giving performance in disease control over three years are in preparation for publication. Fungal diseases are also controlled by the mercury treatment, and, now that an intimate mixing device is available on a field scale, other materials can also be tried with this new process.

(*To be continued*)

* The soil disease control unit mentioned will shortly be marketed by Messrs. Rotary Hoes Ltd., West Horndon, Essex, England. It is made jointly by them and Messrs. E. Allman & Co. Ltd., Chichester—Ed.

† Suitable dusts are being produced by Messrs. F. W. Berk & Co. Ltd., London—Ed.

§ GRAINGER: "A new soil disease control unit". *West Scot. Agric. Coll. Res. Bull.*, 1958, (25), 1–46.

AGRICULTURAL ABSTRACTS

"Endrin" to control Borer. L. L. LAUDEN. *Sugar Bull.*, 1958, **37**, 16.—Preliminary trials on a commercial scale are reported to be most encouraging.

* * *

The Application of Nitrogen Solution in Taiwan Sugar Cane Fields. W. C. HSU. *Taiwan Sugar*, 1958, **5**, (1), 36–41.—The nitrogen solution referred to is a solution of ammonium nitrate and ammonia with a total N content of 37% by weight and a vapour pressure of 1 lb per sq. in. An illustrated account is given of the mode of distribution from storage to field, of the tractor mounting and feed to the rear of the cultivator shoes and of the method of gearing to regulate the rate of delivery.

* * *

Big Stride in Taiwan Sugar Cane Agriculture. K. C. LIU, *Taiwan Sugar*, 1958, **5**, (1), 13–25.—A general review of the progress made in the last 5 years.

COMPOSTING FILTER CAKE

THE value of filter cake as a fertilizer has long been recognised and a very interesting review of the position with regard to its use as such has been given by W. L. OWEN[1] who quotes R. E. ROSENFELD's judgment that its beneficial effects on the soil are greater than indicated by chemical analyses alone. He recalls, too, the observations of VAN ZWALUWENBERG in Hawaii on the reduction of nematode infection as the result of its use and his own observations that this control over nematodes is due to the enormous stimulation of root development. Both F. A. PINEDA[2] and J. J. MIRASOL[3] in the Philippines have recommended its use for maintaining soil fertility, the former developing a new fertilizer "Lomifer" containing, besides filter cake, distillery slops and ashes.

One drawback to the use of filter cake in its raw state, is that it is lumpy, not readily mixed with the soil and, therefore, slow in decomposition. It also contains a percentage, which may be high, of wax, itself a substance highly resistant to decompositon. Here, then, is an additional impetus for the recovery of wax.

The author proceeds to draw comparisons between the various methods now being progressively adopted for the conservation of such wastes as sewage sludge and refuse which extend from the relatively simple "windrowing" or composting in bins—processes which may take months to produce the final product —to the highly mechanized processes like that of the American Dross Disposal Corporation or, in Europe, the Dano process, which complete the digestion process in a few days. The latter are able to deal with the waxes successfully but it would appear best to extract the wax before composting.

It is, perhaps, too early to accept in full the figures presented for the financial aspect of composting filter cake; these are that, for a daily grinding capacity of 1,000 tons, the value of the daily output, after deduction of processing costs, is $163. Comparative figures for refuse disposal in England by normal methods and by composting refuse and sludge indicate that at 10s per ton for the former, compost can be given away ; at 5s per ton, costs break even with compost selling at 15s per ton. Since compost in the open market may fetch anything up to £2 and, in cases, £4 per ton, the process should be highly profitable.

One further statement by the author may be noted. If de-waxing improves the final product as a fertilizer, it also practically sterilizes the filter cake and it may be necessary to restore the bacterial flora before composting—perhaps by incorporating excess bagasse. If there remains much to be discovered before an effective process is developed for a better use of filter cake than in its raw state, the field is shown to be well worth investigation.

H.M.-L.

AGRICULTURAL ABSTRACTS

New or rarely found Pests of Sugar-beet in Bulgaria. V. BOGDANOV. *Bull. Pl. Prot.*, 1957, **5**, No. 1 (8), 84–87 ; through *Rev. Appl. Entom.*, 1958,**46** A, 328.—A list is given of the commoner pests of sugar-beet in Bulgaria. These are *Cleonus punctiventris, Tanymecus dilaticollis, T. palliatus, Psalidium maxillosum, Lixus ascanii, Otiorhynchus ligustici, Gnorimoschema ocellatella, Aphis fabae, Chaetocnema concinna, C. breviuscula* and other flea-beetles, cutworms and wireworms. This is followed by a list of insects observed on the crop in small numbers or for the first time in 1955.

* * *

Automatic Greasing of Cane Trucks. D. A. KENNY. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 115–117.–Cf. *I.S.J.*, 1958, **60**, 234.

* * *

Canefield Locomotive Developments. R. MCDONNALL. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 119–125.—Up to ten years ago, most cane locomotives were steam driven, but economics have dictated a change to diesel powered units. The development of these is described with a detailed account of the principles and operation of the fluid coupling and torque converter.

Lubrication of the Diesel Locomotive. A. C. TATTON. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 127–134.—The oxidation of lubricating oils under conditions existing in modern diesel locomotives is discussed and it is recommended to keep the temperature in the sump below 200°F where possible. Detergency, additives and lubricant testing, filtration and care are also discussed.

* * *

Effects of Gibberellins on Plant Growth and Development. P. W. BRIAN. *Biological Reviews*, 1959, **34**, 37–84.—At the 1958 meeting of the American Society of Sugar Cane Technologists, the reaction of sugar cane to gibberellic acid was discussed by R. E. COLEMAN[4]. A very detailed review is given here of all that is known about the action of this group of growth-promoting substances since their identification some 20 years ago in connection with a disease affecting rice in Japan, *Gibberella fujicuroi*. A bibliography is attached covering some 130 papers.

[1] *Sugar J.* (La.), 1958, **21**, (3), 37–43.
[2] *I.S.J.*, 1955, **57**, 70.
[3] *I.S.J.*, 1957, **59**, 4.
[4] *I.S.J.*, 1959, **61**, 69.

THE FACTORS AFFECTING STABILITY AND FLOCCULATION IN CANE JUICE

By M. C. BENNETT

(Department of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, W.I.)

PART III

Considering first the A series (of figs 7, 8 and 9 of Part II, p. 111), the three raw juices show stability minima around pH 3·5 and very low values above pH 8; from the results expressed in previous papers[4,5] it is suggested that these low stabilities, which are accompanied by the immediate appearance of flocs, are associated respectively with an isoelectric condition of the particles and the precipitation of calcium phosphate. One of the most striking features of these curves is the exceptionally high pH at which the effect of calcium phosphate precipitation appears, for in a normal juice it has been shown[5] that this stability change takes place between pH 5·5 and 6. Clearly, the actual precipitation of calcium phosphate is hindered in these unusual juices.

In figure 8A it is seen that the particle system in B4098 raw juice has minimum stability around pH 3·5, yet from figure 4, the i.e.p. lies at pH 2·1. Previous studies[4] of the protein constitutents of different juices have shown that these constituents have minimum solubility around pH 3·5 and that, effectively, a precipitation of protein takes place at this point. It must therefore be concluded that this precipitation has a much greater effect on stability than does particle zeta potential. However, the effect of zeta potential does show up in the numerical value for stability at this minimum. In B4098 (fig. 8A) the value is 30% but in B37161 (fig. 7A), the value is as low as 10%; in this latter juice the i.e.p. lies around the expected pH 3·5 (fig. 3)—that is, proteinaceous constituents predominate at the surface—and the low stability represents the combined effect of maximum protein precipitation and minimum zeta potential at pH 3·5.

In all three juices, heating to 65°C produces a considerable change in the shape of the stability-pH curve but does not change the numerical values of stability around the raw juice minima at pH 3·5. This is in good agreement with the zeta potential-pH curves in figs. 3 and 4 which also are not changed around the i.e.p. on heating to 65°C.

Figures 8A and 9A show that in these B4098 and B47419 juices the stability increases on boiling (cf. fig. 1 (b)), and in the case of B4098 at pH 7·5, the increase is from 20% to 50%. Changes of this magnitude could have serious consequences in a commercial clarification process. Nevertheless, the similarity here between the behaviour of B4098 and B47419 suggests that the electrophoretic behaviour of these two juices should be similar and it is therefore interesting to note that the zeta potential-pH curve for the B47419 juice (not shown here) is similar to that of B37161 rather than that of B4098; the i.e.p. changes from pH 3·3 to pH 2·4 on boiling for 5 minutes. It appears that either the increases and decreases in stability on boiling are not determined by an electrical change or that desorption has taken place in this B47419 juice prior to measurement of zeta potential so that the values obtained do not apply to the undiluted juice systems in which stabilities are measured. Evidence will be presented below that the latter is the case.

Considering now the B series of stability curves which were determined on systems heated and boiled at each indicated pH, there are two salient features. First, above pH 6 the boiled system is in all three juices less stable than either the heated or the raw juice; this suggests that boiling aids the precipitation of calcium phosphate and provides tentative evidence that a calcium phosphate sol may be formed in these juices under the conditions of the A series of stability determinations. Secondly, below pH 3, the heat treatments do not appreciably change the stability of the raw juices; figure 9B shows this particularly well. It is therefore concluded that the particle surface does not change on heating at pH values below 3 and this may be explained in two ways:

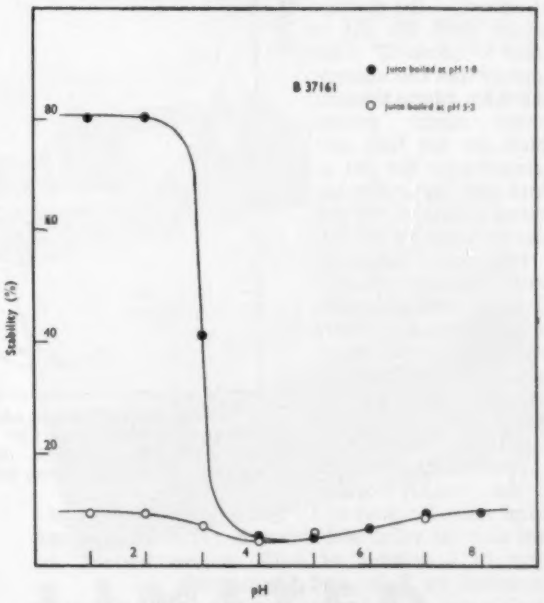

Fig. 10. The change in stability with pH of a cooled sample of B37161 boiled at pH 1·8 compared with that of a sample boiled at pH 5·3. 25 mM EDTA added.

(i) the substances which cause stability changes are not liberated by heat treatment at these lower pH values, or

(ii) the substances are liberated, but they may not adsorb at low pH.

The latter would imply that adsorption at the higher pH values was chemical rather than physical.

The results in figure 10 show that the second explanation is correct ; the juice used for this experiment was the B37161 used above (cf. fig. 7) and the conditions under which stabilities were determined were those of the A series above, i.e., heat treatment was carried out before the pH was adjusted to the values indicated. However, in one case raw juice was boiled at its natural pH 5·3 (as for the results in fig. 7A) but in the other case the juice was boiled at pH 1·8. EDTA was added to remove the effects of calcium phosphate precipitation, as is described below.

It is seen that the two curves converge and join around pH 4·5, below which the stability of the system boiled at pH 1·8 is greater than that of even the raw juice (figs. 1(d) and 7). These curves therefore demonstrate that the substances which affect stability *are* liberated by heat treatment at pH 1·8 but that they do not adsorb at the particle surface until the pH is raised to about 3. This suggests that the adsorption takes place through weakly acidic groups which are not fully dissociated until the pH at which the curve for the system boiled at pH 1·8 joins the curve for pH 5·3. It has been suggested above that the stability effects are associated with the deposition of an acidic polysaccharide in which the ionogenic groups are carboxylic, and from the curve of the system boiled at pH 1·8 (fig. 10) it is apparent that the pH of the weakly acidic groups must lie close to 3 : this is in excellent agreement with the value of 2·95 for the pH of the carboxyl group in a number of acidic polysaccharides, as determined by SARIC and SCHOFIELD[18].

We must conclude from this result that when juices are heated at any pH greater than 3, the substances which are liberated are chemically bound to the particle surface through dissociated acidic groups. When the pH of such systems is reduced below about 3, these substances do not desorb during the time taken for the stability measurements described here and hence in the curves shown in figures 7A, 8A and 9A, the parts of these curves lying below about pH 3 do not represent equilibrium conditions.

(ii) *The effects of phosphate, EDTA and calcium additions.*—In figure 11 are shown the effects on stability of additions of EDTA, inorganic phosphate and calcium to the B37161 juice used above (figs. 1 (d), 7 and 10). It is seen that an addition of 4 mM phosphate to the juice (which already contained 2 mM phosphate) is sufficient to shift the stability effect of calcium phosphate precipitation 1 pH unit

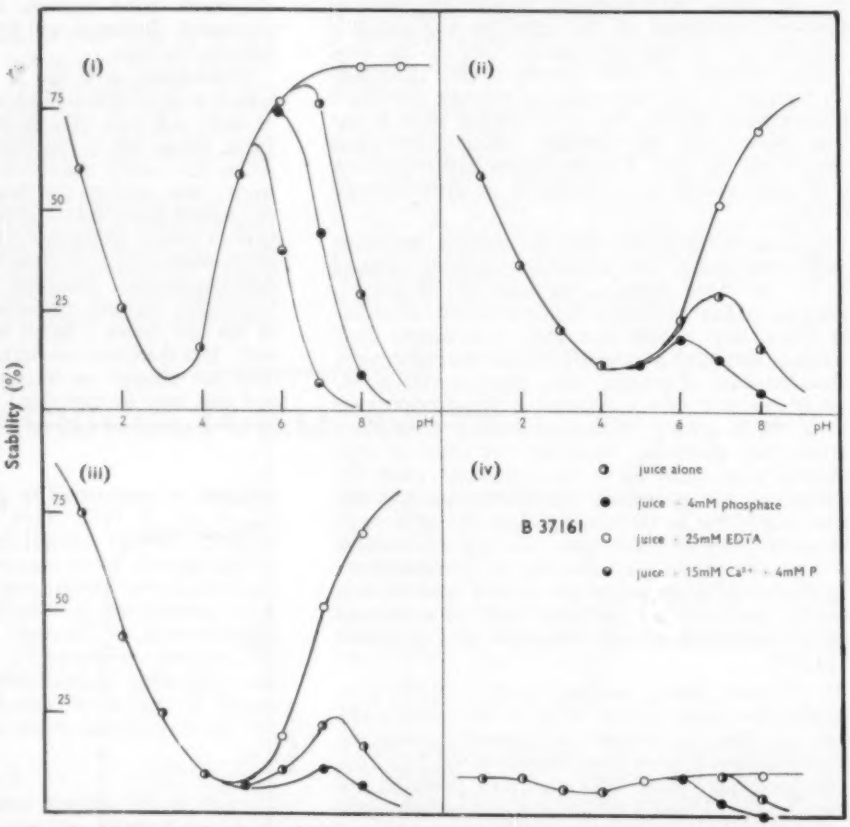

Fig. 11. The effect of various additives on the stability-pH curves for a B37161 juice containing 2 mM phosphate and 19 mM $Ca^{2+} + Mg^{2+}$: (i) raw juice, (ii) juice heated to 65°C for 2 min and cooled before pH adjustment, (iii) juice boiled 5 min and cooled before pH adjustment, (iv) pH adjusted to indicated values before boiling 5 min.

to the left in all curves. However, even at this high phosphate level the sharp break in stability does not occur at the expected pH (5·5—6) and, in fact, it was necessary to add 15 mM calcium to the juice (which already contained 19 mM $Ca^{2+} + Mg^{2+}$) before this

[18] *Proc. Royal Soc.*, 1946, **185A**, 431.

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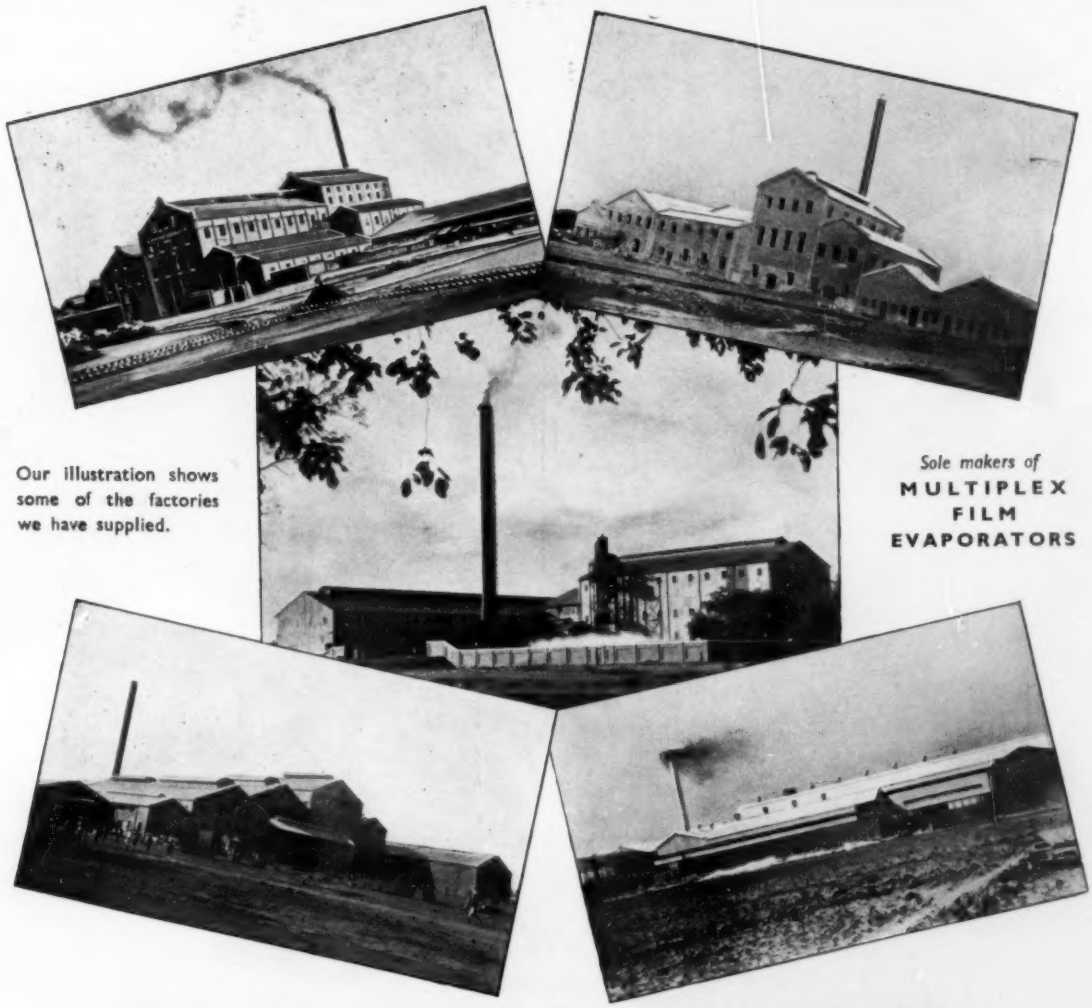

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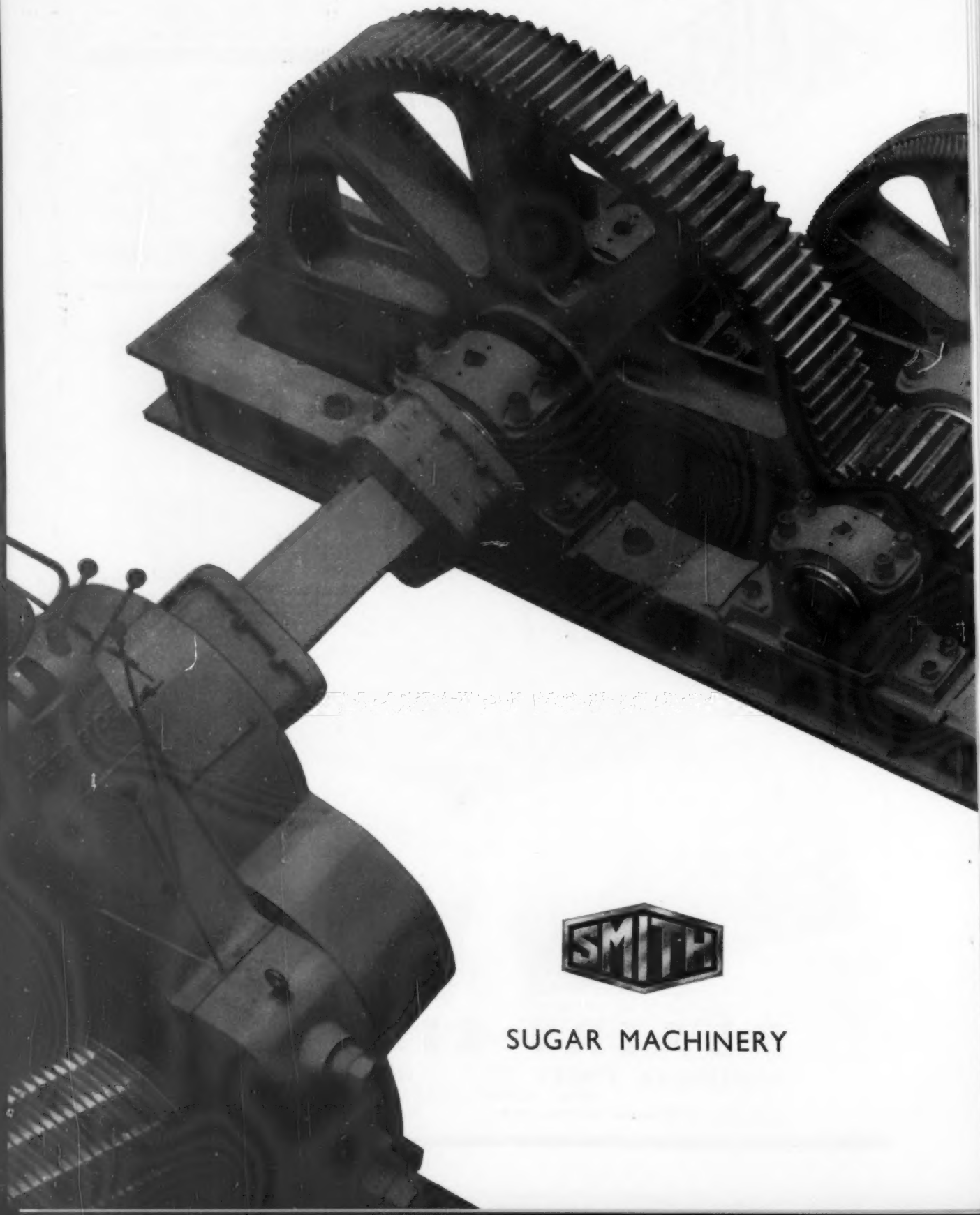

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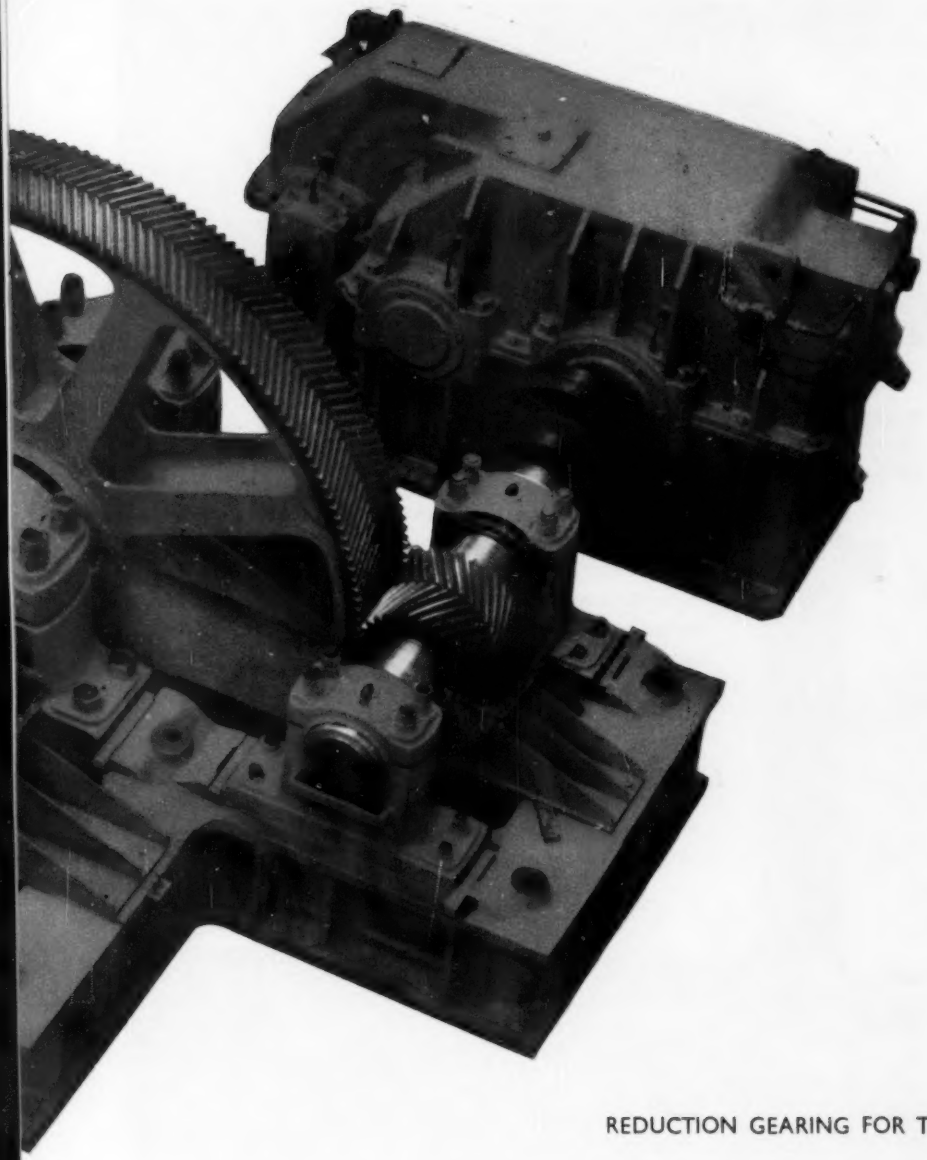

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P.2127

was achieved (fig. 11 (i)). This is another example of the calcium deficiency which has been mentioned in a previous paper[8]. The curves become symmetrical about the pH of minimum protein solubility (pH 3·5) in the presence of 25 ml EDTA which prevented any precipitation of calcium phosphate.

The sets of curves shown in figures 11 (iii) and 11 (iv) are important inasmuch as they allow us to forecast certain features of the commercial defecation process ; the effect of clarification pH, and of phosphate level on clarity are immediately apparent. However, the two sets of curves also enable us to compare the effects of different lime-heat sequences : it is clear that a system of zero stability may be obtained by adjusting to pH 8 *after* boiling, (fig. 11 (iv)) while the reverse process yields a system of 7% stability (fig. 11 (iii)). On this basis it was therefore suggested that the Fractional Liming and Double Heating process[19] would be beneficial in the clarification of this juice and this was subsequently borne out by settling experiments.

The Electrophoretic and Stability Effects of Detergents

Bennett and Haydon have recently shown[14] that, in an oil/water emulsion stabilised with bovine serum albumin, the reversal of charge concentration (0·37 mM) of the cationic detergent myristyltrimethylammonium bromide was independent of both the oil drop concentration and the total protein concentration ; the study led to the conclusion that the detergent interacted with the oil surface rather than with the adsorbed protein layer. Since most of the particles in cane juice are of a waxy composition, these particles may be considered to behave like the oil droplets of an emulsion. The reversal of charge concentration of cetyltrimethylammonium bromide (CTAB) in two of the raw juices used here was found to be very close to the above-mentioned value and it is therefore inferred that the detergent interacts with the waxy particle surface rather than with the macromolecular material adsorbed at that surface.

In figure 12 are shown the curves of zeta potential against concentration of both CTAB and a negative detergent, sodium lauryl sulphate (SLS). Since these two detergents produce effects in opposite directions, the CTAB and SLS curves are continuous and are shown on one graph. It is seen that the samples of B47419 and B37161 (which both gave normal zeta-pH curves for the raw juices) gave the same curve having a reversal of charge point at 0·38 mM CTAB. On boiling the B47419 sample there was a slight shift to 0·40 mM CTAB and the shape of the curve was somewhat changed. It must be concluded that the particle surface has in this case acquired additional negatively charged material. With the B4098 juice, the reversal of charge concentration in the raw juice (0·60 mM) is increased to 0·70 mM on boiling and it is considered that this again demonstrates the existence and further deposition of unusual negatively charged layers at the particle surface.

The curve for B37161 raw juice is not changed on boiling ; here then is an electrical effect which takes place on boiling B47419 and B4098, but not B37161.

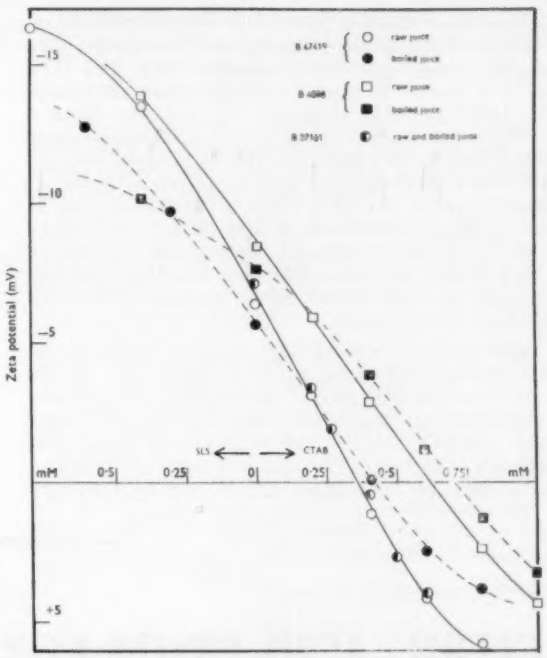

Fig. 12. ζ against concentration of SLS and CTAB in three juices. B4098 and B47419 show a change on boiling.

It is possible that this effect is related to the increase in stability which occurs on boiling B47419 and B4098 (see figs. 8A and 9A) but not in the case of B37161 (see fig. 7A).

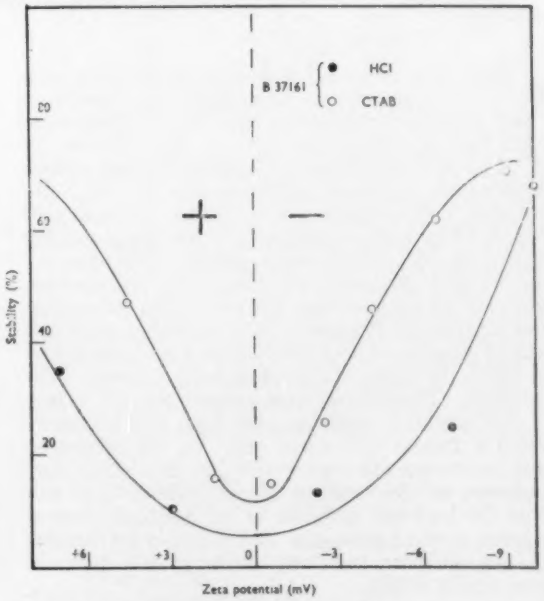

Fig. 13. Stability against ζ in B37161 raw juice. The variation obtained using HCl is compared with that using CTAB.

[19] Davies *et al.*, *I.S.J.*, 1936, **38**, 298.

The zeta potentials quoted here were determined on samples of the various juice systems diluted twentyfold in the required detergent concentration, and once again it cannot be known to what extent desorption has taken place on dilution. The fact that there is a minimum in the stability—CTAB concentration curve (not shown here) for B4098 between 0·6 and 0·8 mM CTAB suggests that in this juice the determined reversal of charge point is the same as that in the undiluted system. In a later paper[20] it is shown that the electrophoretically determined reversal of charge concentration in B47419 is considerably lower than that determined from the sedimentation behaviour of the undiluted juice.

There are two independent means of reducing the zeta potential of particles in cane juice, viz. by the addition of CTAB and by the addition of acid, and it is interesting to plot the curves of stability against zeta potential for the same juice with those two different additives. The curves shown in figure 13 were obtained by adding CTAB and HCl to raw juice samples of the B37161 above ; zeta potentials were taken from figs. 3 and 12, and it is seen that at any given zeta potential HCl gives a lower stability than does CTAB. The difference between the two effects lies in the fact that while CTAB exerts its greatest influence on the zeta potential of the particulate matter, HCl changes both this and the electrical character of material (e.g. protein) in solution in the continuous phase. The experiment demonstrates yet again the dependency of stability on factors other than particle zeta potential, but nevertheless serves to illustrate that the physical behaviour of the particle suspension in cane juice is determined to a very large extent by reactions which take place at the particle surface.

ACKNOWLEDGMENT

This work forms part of the research programme of the British West Indies Sugar Research Scheme.

[20] BENNETT AND SCHMIDT : unpublished.

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CITRIC ACID FROM EGYPTIAN CANE MOLASSES
By Aspergillus Niger

By M. S. E. SALEH* and M. M. MEGAHID

Department of Chemical Technology, Faculty of Engineering, Alexandria University, Alexandria, Egypt.

CANE molasses has received less attention than beet molasses as a carbohydrate source in citric acid production by *A. Niger*. Chatterjee[1] used for an undisturbed surface fermentation by *A. Niger* a 33% solution of Indian molasses corresponding to a sucrose concentration of 14%. He obtained a 62% conversion of sucrose to citric acid and in large scale experiments, it has been possible to convert 50% of the sugar present. The volume : surface area ratio used was about 2·2. No previous treatment of the molasses was mentioned although it was reported by PRESCOTT and DUNN[2] that untreated cane molasses gave poor yields of citric acid which may be due to the high metal or phosphorus content of the molasses. They found that replacement of a part of the synthetic medium with high test molasses, which is known to contain only 3% ash compared with an average ash content of 9% for blackstrap cane molasses, or the addition of small amounts of ash from the high test molasses to this medium resulted in lower yields of citric acid. Ashes from other samples of cane molasses and from untreated beet molasses gave similar results.

Cation exchange resin treatment of cane molasses was found to improve yields of citric acid produced[3]. PERLMAN *et al.*[4] treated cane molasses (an invert variety) with ferrocyanide and obtained better acid yields.

Beet molasses used in citric acid production is usually subjected to different treatments viz.: with cation-exchange resins[5], acid clays[6] and ferrocyanide[7] before it is used in the fermentation.

All these different processes seem to lower the metal or phosphorus content of the molasses under test to a limit at which the biological production of citric acid becomes feasible. It was recently reported[8] that the steam distillation products of molasses, mainly formic, acetic and propionic acids, act as inhibitors on *A. Niger* spores.

* Present Address : Westdeutsche Gerberschule, Reutlingen, Germany.

[1] *J. Indian. Chem. Soc., Ind. & News Ed.*, 1942, **5**, 201.

[2] *Ind. Microbiol.*, 1949.

[3] SNELL and SCHWEIGER : U.S. Patent 2,492,667; WOODWARD, SNELL and NICOLLS: U.S. Patent 2,492,673 ; *I.S.J.*, 1951, **53**, 144.

[4] *Arch. Biochem.*, 1946, **11**, 123.

[5] MILES LABS. : U.K. Patent 738,940.

[6] OZAKI *et al.*: *J. Fermentation Assoc.*, 1955, **13**, 437.

[7] BERNHAUER *et al.* : *Biochem. Z.*, 1949, 319, 499, GERHARDT *et al.* : *J. Bact.*, 1946, **52**, 555.

[8] FENEL and LEOPOLD : *Chem. Listy*, 1956, **50**, 645.

Many factors such as temperature of incubation, initial pH of the medium, the depth of the liquid nutrients in surface growth, metal requirements, sugar concentration, etc., influence to a great extent the citric acid yields[9] and should therefore be considered in the fermentation.

Owing to the importance of citric acid in many industries and since cane molasses is the only type of molasses available on the Egyptian market in quantities of about 60,000 tons per annum, this work was conducted in order to evaluate this molasses as a source for citric acid production. Four strains of *A. Niger* were utilised in the course of study, one of these being locally isolated from an old molasses solution. Synthetic media of known composition were used in order to determine the optimum conditions and requirements of the *A. Niger* strains for citric acid production which were afterwards applied to molasses.

Experimental

Organisms: The following strains were examined for their ability to produce citric acid ; *A. Niger* NRRL 67, *A. Niger* NRRL 372, *A. Niger* NRRL 609 and the isolated strain designated T. Since many workers[10] have proved that successive transfers of the mould resulted in better yields of citric acid, the different *A. Niger* strains were repeatedly transferred to fresh liquid medium at an interval of 10–12 days for a 3 month period and once every month they were transferred to sporulation medium slants. The liquid medium had the following composition : 14% sucrose, 0·1% (w./v.) potassium dihydrogen phosphate, 0·25% ammonium nitrate and 0·025% magnesium sulphate ; which is a slightly modification of that proposed by Prescott and Dunn[11]. The medium was adjusted to pH 2·5–3·0 with HCl and sterilised by autoclaving for 30 minutes at 10 p.s.i. The sporulation medium had the same composition with the addition of 2% agar. It was found that further transfer after the 3 month period produced no further increase in acidity. This transfer was maintained during the course of this investigation.

Inoculum : The activated *A. Niger* strains were used for inoculum preparation by inoculating sporulation medium agar slants and incubating at 28°C for 10 days. The resulting heavily sporulated mycelium was shaken with 10 c.c. sterile distilled water and 0·5 c.c. of this spore suspension was used as inoculum.

Chemical Determinations : The resulting acids were titrated with 0·1 N sodium hydroxide using phenolphthalein indicator. Potassium permanganate was used for oxalic acid determination as according to Halliwell[12]. The citric acid content was calculated by difference and expressed as percentage anhydrous citric acid. Sugars were estimated in the synthetic medium by the iodine method of Willstätter-Schudel. This method proved unsatisfactory when working with molasses media and therefore the sugars were determined by Eynon and Lane's volumetric method[13] but using Benedict's solution[14] instead of Fehling's solution in the estimation with the addition of 1% methylene blue to get a sharp end point.

The weights of the mould mycelia were recorded after good pressing, washing, autoclaving, drying at 50°C for 8 hr and storage overnight in a desiccator at room temperature.

The elements in the molasses were estimated according to standard methods after igniting, iron being determined with cupferron and phosphorus as phosphomolybdic anhydride.

Surface Culture Fermentation Technique : Conical flasks of 100 c.c. capacity were used throughout. The nutrient solution under test was distributed in known volumes and the whole were sterilised by autoclaving for 15 minutes at 10 p.s.i. This treatment was found not to act adversely on the sugar present. After cooling, the media were inoculated and incubated. When studying the effect of time and other variables on citric acid yield, samples were withdrawn at intervals, the volume of the fermented liquid measured, made up to 50 c.c. in a measuring flask with distilled water and analysed. It was found that citric acid production reached a maximum after 12 days and in the subsequent experiments, the analyses were carried out after 12 days incubation. The resulting mycelia were weighed.

Results

I.—*Optimum Conditions for Max. Citric Acid Production in Synthetic Liquid Medium.*

The liquid medium had the following composition : 150 g sucrose, 2·25 g NH_4NO_3, 1·0 g KH_2PO_4, 0·25 g $MgSO_4,7H_2O$ and 1 mg Fe, made up to 1 litre. The pH was adjusted to 2·5 with dil. HCl.

(*a*) *Temperature and pH* : These were studied simultaneously. Incubation temperatures of 28° and 33°C ; initial pH values of 2·5, 3·8 and 5·2 were investigated. In each flask, 30 c.c. of the synthetic medium were introduced. A temperature of 28°C and pH value of 2·5 were found to be the best conditions. Values ranging between 4 and 6% for citric acid were obtained for the different strains. This corresponds to 40–63% conversion of sucrose to citric acid. A certain amount of the sugar, about 2–7%, was always found after 12 days incubation. At higher pH values of 3·8 and 5·2, higher rates of sugar consumption were determined although lower yields of citric acid, about 2–3·5%, were obtained. In these cases higher mycelium weights were recorded, 0·65 and 0·85 g respectively, as compared with an average weight of only 0·25 g at pH 2·5. No oxalic acid could be detected in the fermented liquid. A temperature of 28°C and a pH below 3·0 were adopted in the following experiments.

[9] Underkofler and Hickey : "Industrial Fermentations", Vol. I. (Chemical Publishing Co. Inc., New York). 1954, p. 420 *et seq.*

[10] Das Gupta and Guha : *J. Indian Chem. Soc., Ind. & News Ed.*, 1940, **3**, 64; Chatterjee, *loc. cit.*; Prescott and Dunn, *loc. cit.*

[11] *Ind. Eng. Chem.*, 1934, **26**, 1142.

[12] *Anal. Chem.*, 1950, **22**, 1184.

[13] *J. Soc. Chem. Ind.*, 1923, **42**, 32T.

[14] *J. Biol. Chem.*, 1931, **92**, 141.

(*b*) *Volume : Surface area ratio* (*v/a*).—This is a decisive factor in the surface fermentation of citric acid and has been always stressed by many workers[9] and it is thus of great importance to adjust it optimally to get a maximum acid production. A volume of 30 c.c. in the conical flask corresponded to v/a ratio of 1·15. A further three values of 1·0, 1·50 and 1·90 were investigated with the inclusion of the ratio 1·15 in the test series. It was found that with the gradual increase of v/a ratio, the citric acid production increased, also the sugar was consumed at a higher rate by all the strains as is clearly shown in table I, which includes only the 2 extreme values for v/a ratios. The intermediary values of 1·0 and 1·15 exhibited intermediate results.

TABLE I

Strain	v/a	% citric acid	% sugar used	% conversion	mycel. wt. (g)
T	1·0	1·32	4·2	31·4	0·422
	1·90	5·84	11·0	53·0	0·679
NRRL 67	1·0	1·98	5·8	34·1	0·446
	1·90	4·98	12·0	41·5	0·859
NRRL 372	1·0	8·95	14·7	61·6	0·481
	1·90	10·45	14·2	73·6	0·943
NRRL 609	1·0	3·45	9·3	37·1	0·609
	1·90	6·95	12·8	54·3	0·819

The strain NRRL 372 produced 0·28% oxalic acid corresponding to about 2·6% of the total acids estimated at the 1·90 ratio. The other three strains were found to produce less than 1% oxalic acid compared to total acids.

(*c*) *Variation of the Mineral Concentration.*—Combinations of different media in which one or more minerals were deficient or absent were next studied. The series could be divided into :

(i) *Phosphate deficiency* : concentrations of 0·5 and 0·75 g of KH_2PO_4 per litre were found to reduce the amount of citric acid. The conversion rate of sucrose to citric acid fell by about 50% in case of the strains T, NRRL 67 and NRRL 609 at both phosphate levels. The strain NRRL 372 suffered also from the phosphate deficiency but not to such a marked extent. It was able to produce 7·73% citric acid corresponding to a sugar conversion of 61·1%. The weights of mycelia did not appear to change considerably due to the phosphate deficiency.

(ii) *Iron deficiency* : iron was next completely eliminated from the media, in combinations also containing varied phosphate concentrations of 0·5, 0·75 and 1·0 g/litre. With both iron and phosphate lacking at the necessary level for acid production, a considerable reduction in the citric acid yield occurred. The conversion ranged between 15% and 30% for the various *A. Niger* strains. When the phosphate concentration was restored to 1·0 g/litre, but still with elimination of iron, an improvement of the conversion rate was measured although it did not attain its previous level, values of 30–45% conversion being estimated. In all the media, the sugar was almost completely fermented in spite of the iron deficiency and the mycelia weights were within the normal limits.

(iii) *Nitrate and phosphate deficiency* : phosphate was used at the 3 above-mentioned levels with the reduction of the nitrate concentration from 2·25 to 1·75 g/litre. A marked decrease in citric acid yield was observed in the different media accompanied by a slight decrease in the amount of sucrose consumed. Conversion to citric acid was highest at 20% in case of NRRL 372 while it amounted to only 7–15% in the other 3 strains. The restoration of the phosphate concentration in the medium to 1·0 g/litre did not result in any increase of acid produced.

The above results indicate that to obtain a good yield of citric acid, the phosphate, nitrate and iron concentrations must be kept in the molasses medium at the optimal level indicated.

II. *Molasses*

The molasses used in this investigation was partially analysed and found to contain : sucrose 42%, total nitrogen 1·10%, water 23·3%, volatile acids 5·0%, ash 10·4%, iron 0·54% and phosphate 0·15%.

The Egyptian cane molasses has therefore a high ash content and was accordingly subjected to different treatments in order to reduce the concentration of ions as far as possible or to eliminate them completely before it is utilised as a substrate in the fermentation.

(*a*) *Cation Exchange Resin* : A 33% (w./v.) molasses solution was passed 3 times through an "Amberlite" cation exchange resin.

(*b*) *Cation and Anion Exchange Resin* : Part of the decationised molasses solution was then passed also 3 times through an anion exchange resin.

(*c*) *Egg Albumin* : 85 g of molasses were diluted to 120 c.c. with water. Egg albumin (3 g) was dissolved in a small amount of cold water and added to the molasses. The solution was then heated to boiling, filtered hot, allowed to cool, filtered again and the clear filtrate made up to 250 cc.

(*d*) *Potassium Ferrocyanide* : The treatment was carried out in many different ways. After diluting 85 g of molasses to 150 c.c. the pH of the solution was adjusted to neutrality (6·8–7·0), and a solution of 0·2 g potassium ferrocyanide in a small quantity of distilled water was added followed by 10 g kieselguhr. The mixture was left to stand overnight in an icebox then filtered and made up to 250 c.c.

The treatment was repeated using a fresh amount of molasses and a solution of 0·45 g ferrocyanide. The analyses of both molasses samples showed that the iron concentration in the second sample was far lower than in the first and therefore a third lot of molasses was treated with a solution of 0·45 g ferrocyanide at a pH of 4·7 in exactly the same manner.

The different samples of the treated molasses contained varying amount of iron and phosphate as shown in table II.

TABLE II

Method of Treatment	% Fe	% PO_4
Untreated	0·54	0·15
Cation Exchange	0·00	0·144
Cation-Anion Exchange ..	0·00	0·01
Egg Albumin	0·015	0·0075
Ferrocyanide		
a–0·20 g at pH 6·8–7·0 ..	0·045	—
b–0·45 g at pH 6·8–7·0 ..	0·033	—
c–0·45 g at pH 4·7	0·041	0·01

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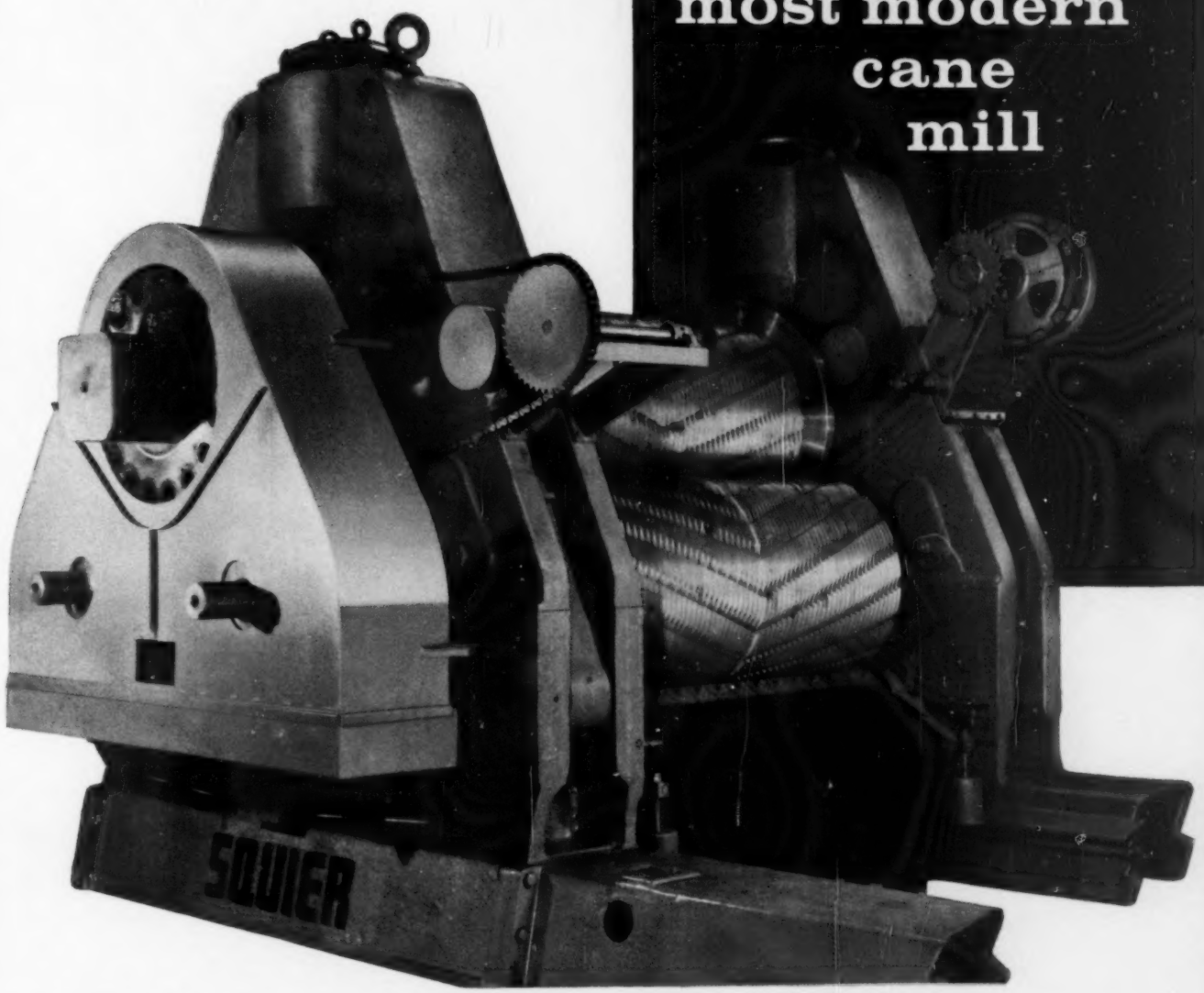

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TABLE III

Medium	*A. Niger* T			*A. Niger* NRRL 67			*A. Niger* NRRL 372			*A. Niger* NRRL 609		
	% Citric Acid	% Sugar used	% Conv-ersion	% Citric Acid	% Sugar used	% Conv-ersion	% Citric Acid	% Sugar used	% Conv-ersion	% Citric Acid	% Sugar used	% Conv-ersion
1–Untreated molasses	1·26	6·8	18·5	1·63	7·8	20·9	1·40	7·3	19·2	1·36	7·0	19·4
2–Cation Exchange resin pH 2·5	1·80	7·4	24·3	1·95	8·5	23·0	2·8	9·7	28·8	0·97	4·5	21·5
3–Cation Exchange resin pH 5·5	2·10	8·3	25·3	2·43	9·2	26·4	3·62	10·4	34·8	1·43	5·7	25·1
4–Cation Exchange resin, Fe and NH_4NO_3 added, no PO_4	3·41	10·1	34·0	4·05	12·0	33·7	5·47	12·0	45·5	3·47	9·5	36·5
5–Albumin, PO_4 added, NH_4NO_3 added	4·88	10·0	48·8	5·18	10·3	50·3	5·94	13·2	45·7	4·01	10·2	39·3
6-Albumin, PO_4 added, no NH_4NO_3	2·48	7·3	34·0	3·64	9·8	35·1	4·13	11·8	35·0	3·52	9·7	36·3
7–0·20 g ferrocyanide, pH 6·8–7·0, NH_4NO_3 added, no PO_4 ..	5·72	11·1	51·5	6·32	11·8	53·5	6·48	11·0	59·0	5·48	10·5	52·2
8–As above, no NH_4NO_3, no PO_4	4·86	9·9	49·1	6·00	11·3	53·1	6·21	10·5	59·1	5·13	10·1	50·8
9–0·45 g ferrocyanide, pH 6·8–7·0, NH_4NO_3added, no PO_4.. ..	5·97	11·3	52·8	6·78	12·0	56·5	6·82	11·0	62·0	6·06	11·2	54·2
10–As above, pH 4·7, NH_4NO_3 added, no PO_4	5·24	10·5	50·0	5·83	10·8	54·0	6·08	10·1	60·2	5·77	10·4	55·5
11–Cation-Anion Exchange, Fe, PO_4 and NH_4NO_3 added ..	2·54	8·3	30·6	1·43	7·1	20·1	2·94	9·8	30·0	1·85	8·0	23·1

Surface Fermentation of Molasses: Untreated molasses as well as the treated samples were diluted with water to give a 33% solution corresponding to 14% sucrose. Inoculation and incubation (at 28°C) were performed as described before. A v/a ratio of 1·90 was adopted. To the molasses media, in which the necessary minerals are absent or present in minimum quantities, calculated amounts of these substances were added to give the optimal concentration required for citric acid production as determined experimentally i.e. iron was added to give a concentration of 1 mg/litre and, when thought necessary, 2·25 g ammonium nitrate/litre were also included in the medium. The phosphate addition was regulated so as to produce a final concentration of 1·0 g KH_2PO_4/litre. The initial pH of the diluted molasses was found to be 5·5–6·0 and was left unaltered unless otherwise stated.

The results exhibited in table III indicate the remarkable influence of the nature of the method of treatment on the citric acid yield. The ion exchange resins did not improve considerably the ability of the mould strains to produce more acid. On the other hand, about 50–60% of the sucrose present in the ferrocyanide treated media was converted to citric acid. If we consider 1 g of citric acid to be produced from 1 g sucrose, which is very nearly the theoretical value, we get 56·1% conversion of sucrose to anhydrous citric acid. In industry, higher conversion rates of 70–75% have been reported[9,15] and in the light of these considerations, the conversion rate attained during this investigation with cane molasses could be of industrial significance. The combination of *A. Niger* NRRL 372 and the ferrocyanide treatment may be therefore of local potential value in citric acid production.

The oxalic acid produced by the *A. Niger* strains was less than 2% of the total acidity. The unconverted sucrose left in the media could be utilised again since on further inoculation with a spore suspension, it has been possible to detect titratable acidity.

Although the egg albumin treatment is here a novelty, it indicates that many undesired inhibitory substances are removed by coagulation causing an improvement in the citric acid yield.

[15] STANLEY : U.S. Patent 2,739,923.

New Fiji Sugar Company[1].—An Indian company has been registered in Suva, Fiji, with a nominal capital of £1 million, to carry on business as a producer and refiner of sugar. The registered office of the Company will be at Nausori. The C.S.R. Co.'s mill at Nausori is to be closed down this year and the Company is at present carrying out a large-scale reorientation programme to fit the district for a changeover from sugar cane to other crops.

* * *

Cuba-Israel Trade Agreement.[2]—Under the terms of a trade agreement which has recently been signed, Cuba will sell Israel sugar in return for goods consisting mainly of textiles and plywood.

* * *

Hungarian Sugar Production, 1958/59.[3]—The 1958/59 campaign in Hungary has finished, with a total of 1,979,080 metric tons sliced by the eleven factories (1,769,030 in 1957/58). Sugar production amounted to 298,398 metric tons, raw value, (275,656 tons in 1957/58) and molasses produced was 83,517 tons (71,867 tons).

* * *

National Sugar Refining Co. Annual Report.—Total melt during 1958 was 1,060,452 tons compared with 1,046,455 tons in 1957. The Company has started a long-range programme to reconstruct and replace certain large installations in the New York refinery. As a first step, the filtration station has been re-located and re-equipped to place it on an automatic basis. This modernization has accounted for $1 million. A new liquid sugar plant and distribution centre has been opened in Cincinnati, producing liquid and invert sugars for industrial customers.

[1] *Australian Sugar J.*, 1959, **50**, 831.
[2] C. Czarnikow Ltd., *Sugar Review*, 1959, (389), 18.
[3] F. O. LICHT, *International Sugar Report*, 1959, **91**, (1), 7–8.

CONTINUOUS DIFFUSER TEST IN HAWAII

THE Hawaiian sugar industry has already made a preliminary test run on its new 20-ton per hour continuous diffuser[1], and full scale research work will be under way this month. Dr. JOHN PAYNE, principal technologist of the Experiment Station, is directing the research and GEORGE APPEL is H.S.P.A. project chief.

Preliminary operation was undertaken for a few days before the end of 1958; however, Kekaha shut down for their annual overhaul and further diffuser runs are scheduled to be made when grinding is resumed in March.

Object of the research is to determine efficiency of the diffusion process compared with conventional methods of sugar extraction by grinding through a mill train. It is hoped to increase extraction of sucrose from the cane from some 94½% to about 98%.

The Silver diffuser during installation.

A major obstacle to the diffusion is the fact that to get efficient results, cane must be cut or chopped so that at least one dimension does not exceed ¼ inch. H.S.P.A. has spent considerable time in trying to overcome this problem.

The diffusion principle is not new. Experiments were carried out in South Africa, and reported in the 1957 Durban Conference of the South African Sugar Technologists.[2] Years ago some small factories in Java used a system of diffusion which achieved better extraction than obtained from conventional mills. H.S.P.A.'s project is a continuous operation which would allow efficient operation on a large commercial scale—should it prove practical.

Scientists of the H.S.P.A. hope that they can gain enough information to allow an appraisal of the continuous diffuser by the end of 1959. Many problems face them ; not the smallest is the matter of rocks brought in from the fields with sugar cane, as a result of Hawaii's all-mechanical harvesting methods. Preliminary tests indicated that rock clearing methods in cleaning plants do not remove all of the small stones. This could be a major problem, if a solution is not found. Chopping the cane in uniformly fine pieces is another major problem which appears to be less than completely solved.

Successful tests of the Silver–D.d.S. continuous diffuser could spark a technological revolution in the cane sugar world. Larger units cost about U.S. $500,000, at least one-half cheaper than conventional mill trains. And, if extraction can be stepped up 3% or more, a diffuser could pay for itself in a short period of time. This research in Hawaii will be watched carefully by the sugar world.

Grading and Marketing of Gur[3].—The Directorate of Marketing and Inspection of the Indian Ministry of Food and Agriculture has issued a booklet explaining the methods of grading, packing and marking of sugar cane gur or jaggery. It contains references to the Sugar cane gur (jaggery) (Grading and Marking) Rules, 1943, and the grade specifications laid down under them, and is available from the Manager of Publications, Civil Lines, Delhi.

* * *

Japan-Haiti Trade Agreement[4].—A commercial treaty between Japan and Haiti was signed on 17th December 1958, providing most-favoured nation treatment and trade development between the two countries. Japan hopes to increase its exports to Haiti this year by $7 or $8 million through increased sales of capital goods, such as sugar mills.

* * *

New Burma Sugar Factory[5].—A fourth factory is to be built in the area of Hninpale and Bilin. The sugar consumption of the country has been limited to 53,000 tons a year by a drastic system of rationing. The three sugar factories now in operation will be capable of producing 63,000 tons of sugar in 1959–60.

[1] *I.S.J.*, 1959, **61**, 63.
[2] *I.S.J.*, 1959, **61**, 115.
[3] *Indian Trade J.*, 1959, **207**, 162.
[4] *Willett & Gray*, 1959, **83**, 51, 53.
[5] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 4), 57.

Aguadilla Terminal Nearing Completion. A. RIOLLANO. *Sugar y Azúcar*, 1958, **53**, (7), 34–35.—The store and conveyor system at Aguadilla, Puerto Rico, are briefly described.

* * *

Industrial Sugar User Saves $15,000. ANON. *Sugar y Azúcar*, 1958, **53**, (7), 41.—Receiving 7000 lb of sugar daily in Tote Bins[1] instead of 25-lb bags has saved a New Jersey preserve manufacturer $14,580 per year.

* * *

Suspended Matter in Affination Syrup of Refineries. Existence of Aconitic Acid. M. KOMOTO, T. MAEDA and E. HAMAGUCHI. *J. Agric. Chem. Soc. Japan*, 1957, **31**, 26–29 ; through *S.I.A.*, 1958, **20**, Abs. 543.—Affination syrups from four imported raw sugars were centrifuged and the suspended matter thus separated was analysed for moisture, sucrose, reducing sugars, crude fat, crude protein, crude fibre, hemicellulose, pectin, and ash constituents in detail. The dried suspended matter was acidified and extracted with ether to yield white powders or colourless columnar crystals which were found, by paper chromatography, to be aconitic acid. Water-washing removed the aconitic acid from the raw sugars in which it was present. The content of aconitic acid in the suspended matter was 25·5% for Cuban, 29·1% for Brazilian and 8·5% for Peruvian samples ; it was absent from Taiwan material.

* * *

The Electronic Cuitometer in the Refinery. G. PIDOUX and J. BALLAND. *Ind. Alim. Agric.*, 1958, **75**, 483–487.—Further details are given of the mode of operation of the electronic conductivity meter described previously[2].

* * *

Technical Aspects of the Indian Sugar Industry and Utilization of its By-Products. B. B. GAIROLA. *Indian Sugar*, 1958, **8**, 65–70.—Indian sugar production is reviewed generally and the advantages and disadvantages of the carbonatation and sulphitation clarification processes are discussed. Instrumentation in the pan station and the installation of high speed centrifugals, at least for final massecuite curing, are advocated. Fondant seeding of final strikes is also recommended. Fuel efficiency is discussed with reference to bagasse production and the introduction of extra boiler house equipment to increase efficiency and the use of electrical power are dealt with from the economics viewpoint. The use of surplus bagasse for paper production, or molasses for animal fodder (and even human consumption), and of press cake as a fertilizer are discussed. It is pointed out that there is little demand for the total alcohol produced from molasses, and the production of e.g. acetic acid and acetone, etc., is considered in relation to the competition from foreign petroleum by-products.

* * *

Hydraulic Handling of Granular Carbon. D. F. GILLETTE. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—A hydraulic system is described for conveying of the syrup slurry of granular carbon from its point where the carbon is revivified to the system where the carbon is used. The advantages of this system over the conventional elevators and conveyors which it replaced are pointed out, and some of the control devices which were found necessary to ensure trouble-free operation are discussed.

* * *

Carbonatation of Refinery Melt Liquors. F. M. CHAPMAN. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—Defecation by carbonatation has been used in some refineries for more than 75 years. It is a robust process which requires no particular skill in operation and the reagents used are cheap. On the other hand the plant is heavy and bulky, and cleaning of the flue gas before compression can be troublesome, lime plant is dirty and somewhat expensive to maintain, and the disposal of the sludge can be a problem. The design and arrangment of plant for the various operations is discussed and some data given on the performance of filters.

* * *

Centrifugal De-Sugaring of Clarifier Scums. W. A. BEMIS. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—A model BR PX209 De Laval self-operating centrifugal separator was installed at Revere Sugar Refinery for the purpose of evaluating the practicability of de-sugaring clarifier scums. The results obtained are reported and sugar losses and sweet-water production by various methods are discussed. The results of some test runs with diatomaceous earth-type slurries are reported.

* * *

Layer Filtration in the Treatment of Refinery melt Liquor with Powdered Activated Carbon. H. J. JACOBS. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—Several years' experience with layer filtration at the Georgia refinery of the South Coast Corporation have demonstrated that the treatment of refinery melt liquor by this method is simpler and more efficient than the old conventional counter-current method. The advantages

[1] *See I.S.J.*, 1957, **59**, 294.
[2] *I.S.J.*, 1958, **60**, 297.

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of the layer filtration method are : (i) the operation is much simpler and is subject to closer supervisory control ; (ii) the carbon handling can be confined to a small enclosed area and station cleanliness can be better maintained ; (iii) a substantial reduction in labour is obtained ; and (iv) maintenance of pumps, tanks, pipelines, etc., is substantially reduced.

* * *

Granular Activated Carbon Decolorization System at Industrial Sugars Inc. G. W. SPINK and D. W. GILMORE. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicans Inc.*, 1958.—The recent installation of a new granular activated carbon system for the decolorization of liquid cane sugar at Industrial Sugars Inc. is discussed. Designed around Pittsburgh Type CAL granular carbon, the facilities include closed circuit hydraulic handling of carbon to and from decolorization columns, a direct-fired rotary kiln for reactivation, followed by a cold water quench bath for cooling the hot carbon. The decolorization performance results and equipment design are reviewed.

* * *

Designing a Dextrose Refinery for Automatic Control Operation. J. N. SWARR. *Paper Presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—A multi-channel dextrose refinery had deteriorated to the extent that early large-scale replacements of equipment were necessary. Replacement in kind would be paid for out of depreciation reserve with essentially no increase in capitalization. On the other hand, the plant could be completely modernized with a considerable increase in capital cost. This could be justified only if the modernized refinery would reduce costs sufficiently to yield a satisfactory return on the excess investment. A description is given, by means of a number of examples, of how this was achieved using a design, the essential feature of which is a centralized process control system.

* * *

Evaluation of the Efficiency of Multiple Evaporators in the Sugar Industry. P. HONIG. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—The principles of the design of modern evaporators as to the size and dimensions of tubes, the main construction materials of tube sheets, the inlets and outlets for the juices or liquors to be concentrated, the distribution of vapours in the calandrias and the principles for removal of incondensible gases are briefly discussed. The systems for the determination of the overall heat transfer which can be applied under operational conditions are sketched and the results of a continuous recording of the overall heat transfer are illustrated with some practical examples. The effect of scaling, deficiencies in the removal of incondensible gases and imperfections in the removal of condensate are discussed with a few practical examples. The main factors in the removal of the incrustations are outlined and how it is possible, under practical conditions, to determine in a simple way the completeness of scale removal. The different modern techniques for the prevention and removal of scales are reviewed and an opinion is given on the efficiency and the economy of different systems that have been proposed, tested and applied today in modern factories.

* * *

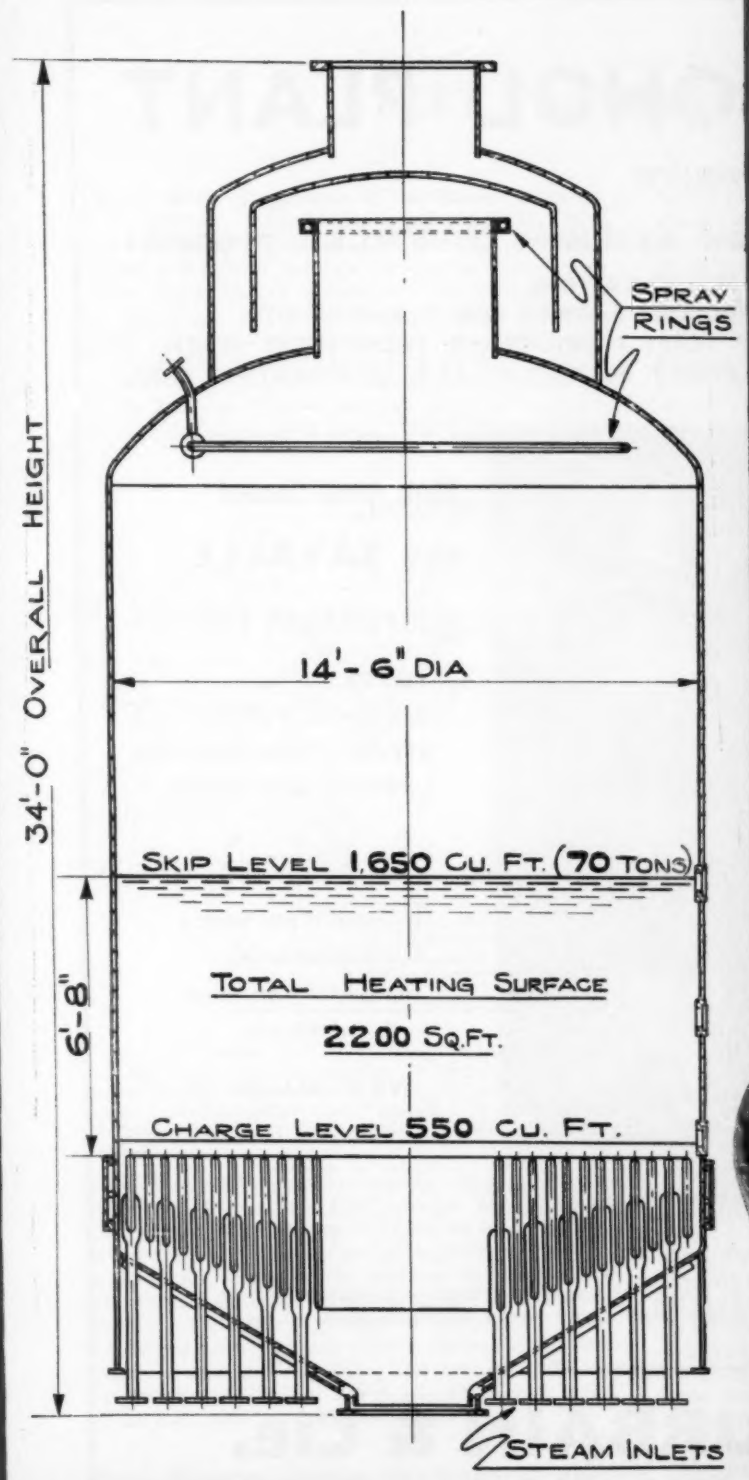
Performance of Recent C. & H. Design Calandria Pans. E. C. GILLETT, D. B. LOTT, and R. S. PATTERSON. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—Characteristics and performance of two new calandria pans at California & Hawaiian Sugar Refining Corp., Crockett, Calif., U.S.A., are discussed. Some of the relationships between the various factors of good pan design, pan capacity, proper boiling techniques, instrument control, sugar quality and yield are covered. One pan has been in remelt sugar boiling service for three years and its performance, with respect to capacity and quality of sugar, is compared to older C. & H. coil pans in the same service. Another pan of the same type has recently been put into service boiling white sugar. The performance of this pan is compared with that of a calandria pan of older design which the new pan replaced.

* * *

Colour Control in Liquid Sugar Manufacture. J. PAVONE and J. SYLVESTER. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—Vegetable carbon is used to absorb colour and turbidity in the final stage of liquid sugar manufacture. The use of this kind of activated carbon makes it imperative to control the processing variables for best results. Double char filtered liquor is carefully chosen for liquid sugar manufacture and adjusted to the proper pH for optimum colour adsorption. Care must be taken to avoid side reactions when the process is susceptible to dissolving unwanted trace elements.

* * *

An Approach to the Improvement of Packaging Operations. C. ESPY and H. WITTKAMP. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—For the past few years there has been a relative increase in small and specialty packages. Naturally with this increase there has been an overall increase of labour in the packing house. The packaging house has always been an important station but with this relative increase of differential packages the importance has been multiplied. There are many questions sugar producers can ask themselves concerning packaging operations, such as (i) Are they operating at maximum efficiency ? (ii) In what areas of the packaging house should money and energy be concentrated ? (iii) What are future expansion plans ? A logical approach to the improvement of packaging operations should therefore be developed, this approach taking into consideration labour cost for packing, machine maintenance costs, machine efficiency and downtime, estimation of peak and yearly trends of particular packages, scheduling of production and warehousing, and machine supplies (paper bags, etc.).



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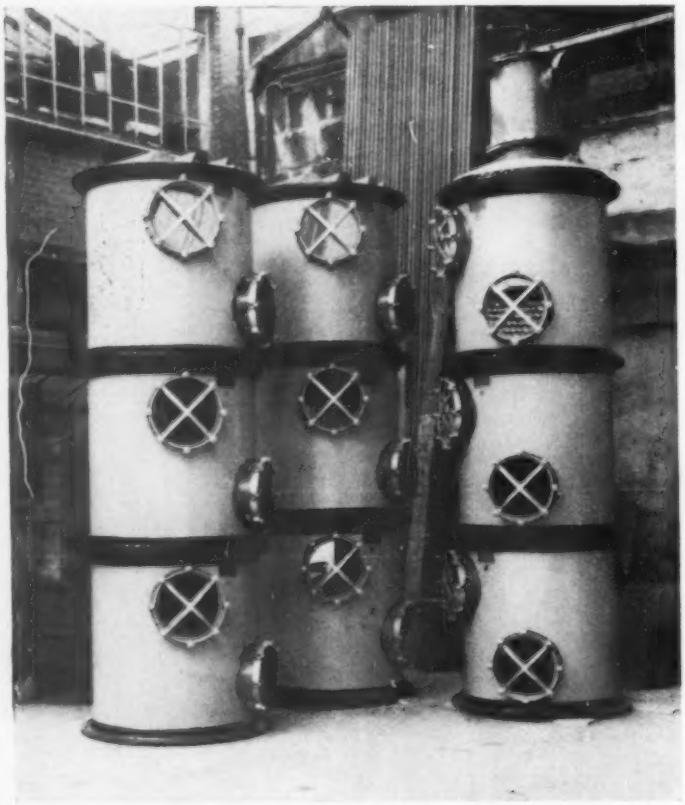

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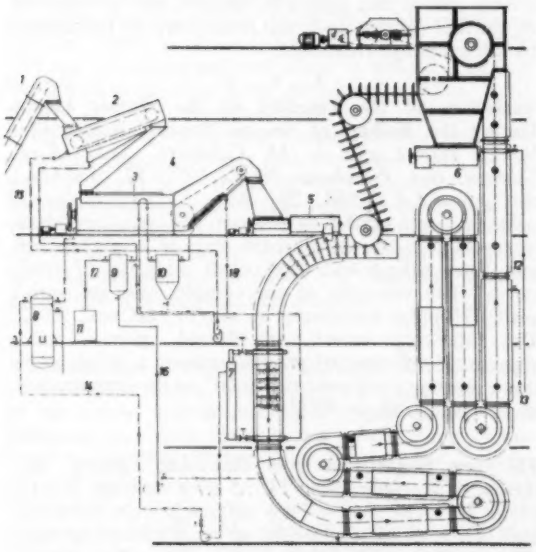
BEET FACTORY NOTES

The O. & D. (Oppermann & Deichmann) Diffuser. H. J. DUNKER. *Zeitsch. Zuckerind.* 1958, **83**, 317–323.—The Oppermann & Deichmann continuous diffuser is described and data obtained in operation at Lehrte sugar factory are given. The piping is of 1·3 metres i.d. and has an overall length of 93·35 metres ; it is constructed of 7 mm thick steel plate. The horizontal sections have a slope of about 1 in 30 to allow air to escape. The conveyor is divided by carrier plates at 478 mm intervals into 234 sections, 195 of which are in the diffuser. The 3 units at Lehrte



KEY : 1. Cossette rake ; 2. Scalding separator ; 3. Juice scalding mixer ; 4. Cossette separator ; 5. Feed scroll ; 6. Withdrawal scroll ; 7. Juice level tube ; 8. Preheater ; 9. Pulp catcher ; 10. Sand catcher ; 11. Juice tank ; 12. Fresh water ; 13. Press water ; 14, 15, 17. Raw juice ; 16. Pulp ; 18. Return conduit.

are each of 1100 tons daily capacity, using a conveyor speed of 1·015 m/min and 54% charge. Mean contact time is 75·8 min, 69 tons of cossettes being treated at any instant. Cossettes are pre-scalded in raw juice at 78°C for ½ min in the scalding mixer and for 4 min in the scalding separator at 72°C. Losses are 0·21% on beet with a draught of 118%. Press water is returned with condenser water as make-up. Cossette length is 16·4 metres/100 g. The average diffusion temperature is 71°C and pH is 6·0. Details are given of the automatic controls and regulators.

* * *

Plastic Protective Coatings. A. WOODS. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 568–572.—A number of resin coatings have been tested as anti-corrosive protection ; several have been successful as is shown in a table. Emphasis is laid on the importance of thorough surface preparation, adequate coating thickness and proper selection of the resin. Several petroleum resins are effective for temporary or semi-permanent protection. Epoxy phenolic resins have been exposed to organic acids in the diffusion battery and standard liquor tank and to mineral acids and alkalis on the Oliver filter and evaporators without deterioration over a year. These plastics have also given satisfactory service inside the liquid sugar melter and storage tanks. Chlorinated rubber base coatings were disappointing and have been replaced, on structural steelwork, by alkyd resin coatings.

* * *

Reloading of Beet Piles in Alberta, Canada. R. B. EVERSON and W. G. SMITH. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 586–589.—The crawler cranes, overhead loaders and front-end loader employed at the three Canadian Sugar Factories Ltd. factories in Alberta are briefly described and their operation compared.

* * *

Theoretical Steady State Distribution of an Additive in Sugar Beet Diffusers. F. STITT. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 611–631.—The distribution of an additive, which is neither consumed nor produced during diffusion, in a model battery, non-model battery and continuous counter-current diffuser, is considered mathematically, taking into consideration variations in the partition ratio between pulp and juice, point of entry, etc.

* * *

Problems of Beet Tail Evaluation. R. LOSERTH. *Zucker*, 1958, **11**, 350–356.—The extraction of sugar from beet tails is considered. It has been shown that the weight of tails constitutes an average of 2·23% (0·88–3·74%) of that of tail-less beets, and that the average pol content is 14·5% (although this is considerably reduced by fluming and washing). Diffusion tests showed that the pol content was reduced from 8·84% (after fluming and washing) to 3·18%, equivalent figures for fresh cossettes being 16·49 and 0·805%. The need for a special diffuser in which to treat the tails is discussed[1].

* * *

Belt Conveyor Bin for Pressed Pulp. W. LANGE. *Zucker*, 1958, **11**, 358–359.—A 70 cu.m. bin installed in the pressed pulp flow-line at Rain-am-Lech factory is described and illustrated. The pulp passes along a rake conveyor and falls into the bin, the bottom of which is formed by a band conveyor, rather longer than the rake conveyor, which is switched on as soon as the pulp pile extends half-way along the bin. The belt conveyor moves in the same direction as the rake conveyor, but at an automatically controlled speed. At the end of the belt conveyor, the pulp is discharged to a screw conveyor feeding the drum dryer. A second, small rake conveyor is located at

[1] *Cf.* OGER : *I.S.J.*, 1957, **59**, 286.

the end of the bin, parallel with the sloping end wall, and ensures an even flow of pulp, in a loose state. Impulses to the variable-speed motor of the belt conveyor are transmitted by six photo-cells mounted in the side walls of the bin, and reduce or increase the speed according to the rate of filling. The speed of the dryer feed screw is also varied and each change transmits an impulse to the air, fuel, and temperature controls of the dryer.

* * *

Statistical Examination of the Determination of Sugar Stock in Progress. G. VAVRINECZ and E. VALKOVSZKY. *Cukoripar*, 1958, **11,** 27–31; through *S.I.A.*, 1958, **20,** Abs. 518.—The stock can be calculated from volume, Brix and pol values, or from dry solids figures, converting syrups to the massecuite equivalent and then multiplying by pol/100. Errors in measurement are less than those possible in the calculation. The greatest source of error is determining the sugar in the pans. Part of the sugar in process is a variable amount which is in unmeasurable positions. Daily records are required, and unusual losses will then be found if there is a deficit over several days.

* * *

Mechanization of Dried Cossette Storage. M. CZIRFUSZ. *Cukoripar*, 1958, **11,** 13–15; through *S.I.A.*, 1958, **20,** Abs. 522.—Dust cyclones are used for pneumatic transport of dried slices. The theory of the action of cyclones is discussed and the dimensions of the cyclone required for separating the cossettes from the air are considered in detail. The loss of material from incorrect dimensioning is calculated.

* * *

Influence of pH on the Peptization of Pectic Substances from Fresh Beet. K. D. ZHURA. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1957, **17,** 17–20; through *S.I.A.*, 1958, **20,** Abs. 523.—Beet cossettes were immersed in aqueous solutions at different pH for 70 min at 70°C; the extracts were filtered and their pH and contents of pectic substances determined. Minimum extraction of pectic substances occurs at pH 6·5–6·7; extraction increases with alkalinity and the use of ammoniacal water for diffusion is therefore not recommended.

* * *

Control of the CO_2 Content of Saturation Gas. S. MÉSZÁROS. *Cukoripar*, 1958, **11,** 36; through *S.I.A.*, 1958, **20,** Abs. 526.—An instrument for continuous determination of CO_2 in gas is the "Simplex-Monox"; the "Duo-Monox" also measures the CO content. Amounts up to 40% of CO_2 can be measured. The values obtained are different from those given by the usual Orsat instrument.

* * *

Separation of Predefecation Muds in the Purification of Beet Juice. V. TIBENSKY and Z. KOHNOVÁ. *Chem. Zvesti*, 1958, **12,** 231–243; through *S.I.A.*, 1958, **20,** Abs. 527.—Predefecation muds require thickening before they can be filtered on a rotary vacuum filter, but hitherto simple sedimentation and decantation have not been sufficient. An improved method of predefecation is described whereby muds are obtained which can easily be thickened by sedimentation to twenty-fold density. The Dedek-Vasátko progressive liming method, adding 0·25 g of CaO per 100 ml of juice at 85°C, is followed by simultaneous defecation and saturation to the alkalinity of 2nd carbonatation (0·02% CaO), which requires a further 0·2 g CaO/100 ml. The muds thus obtained contain three times as much protein, organic compounds and P_2O_5 as in the usual 1st carbonatation muds, and 70% inorganic matter (mostly $CaCO_3$), with a saponin content below 0·1%. Such muds are very suitable as a fodder ingredient. The filtered juice from this process has a dark colour and high ash, but this can be removed by further liming and saturation or, in particular, by ion exchange treatment.

* * *

Variations of the Viscosity of the Mother Liquor During the Boiling of Second Product Massecuite. V. D. POPOV and A. M. CHERNYI. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1957, **17,** 109–114; through *S.I.A.*, 1958, **20,** Abs. 537.—Samples of solution were withdrawn from the massecuite at intervals of 5–10 min until the start of crystallization and then before and after each addition of fresh syrup. The viscosity of the samples was measured with a Höppler viscometer at 60°, 70°, 80° and 90°C. The following values are plotted against time: apparent coefficient of supersaturation; solids content; purity; and viscosity at 80°, at the temperature in the pan, and at 90°C.

* * *

The New Sugar Pan from the Láng Factory. G. BAJOR. *Cukoripar*, 1958, **11,** 25–27; through *S.I.A.*, 1958, **20,** Abs. 599.—This calandria pan is 6·4 m high, 4 m in diameter, has 200 sq. m. of heating surface, 679 tubes and 400 quintals capacity. The pan is wider than usual in relation to its height, resulting in lower hydrostatic pressure, and has a wide downtake ensuring good circulation. Heating can be carried out with second and third evaporator body vapours and boiling times can be shorter. It is particularly useful for low-grade work, giving better exhaustion. Satisfactory results were obtained at Sárvár factory in 1957.

* * *

Use of Cheap Jute Fabric. S. GAWRYCH. *Gaz. Cukr.*, 1958, **60,** 212.—When jute cloth T510 (weight 510 g/sq.m.) was used at Lublin factory in 1957, it was found that although as many as four cloths were used together, the juice was still not filtered satisfactorily. The cloths are individually cheaper than FD 710 cloths (weight 710 g/sq.m.), which had been in short supply in 1957, but become more expensive when used in such numbers.

* * *

Sulphitation of Thin Juices. H. ZAGRODZKI and A. ZAGRODZKA. *Gaz. Cukr.*, 1958, **60,** 213–214.—Results of tests carried out on thin juice, in which this was either gassed with SO_2 or CO_2, showed that

the colour increase was smaller during the evaporation of the former. Sample determinations are tabulated and support the author's view that sulphitation should not be abandoned in Polish sugar factories, as is the general trend at the moment.

* * *

Performance of Battery Diffusers using the Szarejko Method. L. GARCZAREK. *Gaz. Cukr.*, 1958, **60**, 215–218.—The Szarejko return-water system at Brzesc Kujawski factory is described. The diffusion water and press water are freed from sand, pulp, etc., in a decanter and the turbid underflow sent to waste. Of the purified water, 15% is limed and used to sweeten-off the filter-presses, one-third of this then being used to sweeten-off the low-grade equipment. The remaining two-thirds is used with 25% of the remaining unlimed water to flush the empty diffusion vessels, and the remaining unlimed water is used to displace the diffusion juice from the penultimate vessel. Iron screens in the pulp presses have been replaced with brass screens because the former became corroded after one campaign, and nickel-chrome mesh in the pulp strainers was replaced with phosphor-bronze for the same reason. Mean battery losses during 1957 were 0·89% on beet, while sugar quality was not reduced. Detailed campaign results are given and the economics discussed ; a flowsheet is also given, and a water balance diagram.

* * *

Modernization of the Rotary Diffuser. M. S. GABOVICH. *Sakhar. Prom.*, 1958, (7), 8–12.—The principles of the single- and double-scroll rotary diffusers are discussed and theoretical output of the latter calculated to be 53% higher than that of the former, all else being equal. A single-scroll diffuser at Kuibyshev factory was modified according to a suggestion by V. M. VOLKHVYANSKII, whereby inclined trays were placed immediately beneath the radial screens but allowing sufficient room for juice flow. At each revolution of the drum, the juice falls through the screens onto the trays, passing through an opening cut in the scroll blade to the next cell. Thus the juice flows in two streams. The modified diffuser operated faultlessly for 200 days during the 1957/58 campaign with an average daily throughput of 1101·5 metric tons, compared with 983·6 tons in 1956, before conversion. Draught and losses were roughly the same as before. Maximum daily average slice for a 10-day period was 1171 tons, compared with 1071 tons in 1956. Retention time before conversion was 68·6 min, at 27–28 r.p.h., and afterwards, 58·9 min at 24–25 r.p.h.

* * *

The use of Hydrocyclones in the Sugar Industry. V. A. ZAMBROVSKII. *Sakhar. Prom.*, 1958, (7), 12–17.—Tests in which 75 mm-dia. hydrocyclones were used to remove sand, etc., from milk of lime have shown promising results. The effect of feed pressure and the diameter of the mud discharge nozzle on the amount of purified milk-of-lime (% on original) and calculation of the required milk-of-lime feed, based on factory requirements and lime density, are discussed. The factors affecting the degree of purification and thickening are also considered.

* * *

Rate of Exhaustion of Final Molasses. L. S. TVERDOKHLEBOV and I. N. KAGANOV. *Sakhar. Prom.*, 1958, (7), 20–21.—The crystallization rates for 3 molasses samples of 83·6%, 87·2% and 89·8% solids, were studied at 40°C ; the times required for exhaustion were 2, 5 and 7 days, respectively, indicating the slowing effect of increasing Brix.

* * *

Cleaning a Pulp Trap in Operation. P. I. STASEVSKII. *Sakhar. Prom.*, 1958, (7), 26–27.—A cylindrical juice screen is cleaned in one minute by backwashing, and the juice and pulp returned to the nearest diffuser.

* * *

Pulp Traps and Juice Measuring Tanks. E. G. YAREMENKO. *Sakhar. Prom.*, 1958, (7), 30–32.—The claims regarding the automatic pulp trap[1] previously described are not supported and the open stationary and rotary pulp traps considered better. Fitting measuring tanks with conical or sloping bottoms has been found effective in foam removal.

* * *

Storing and Loading Consumption Sugar. H. EUTENEUER. *Zucker*, 1958, **11**, 377–381.—The bagging, storage and loading equipment at Jülich sugar factory are described and illustrated. The sugar is bagged in 100 and 50-kilo sacks, each at the rate of 450 sacks per hour. A belt weigher is used to check the normal sack scales which are liable to error due to dirt. If a sack is outside the tolerance range of ±25 g the belt stops and only starts again when the weight is within the tolerances. The warehouse equipment and conveyor layout are described ; the six types of sugar stored are stacked and removed from the piles by means of a "stacking crane". A diagram is given of the complete bagging, storing and loading equipment and full details are given in a key to this diagram.

* * *

Bacteriological Control in South German Sugar Factories. S. LORENZ. *Zeitsch. Zuckerind.*, 1958, **83**, 392–399.—Bacteriological control in 10 factories in Southern Germany is reviewed and the bacterial infection in a tower diffuser compared with that in a battery. The investigations show that while infection in the tower, raw juice and circulating press water can be controlled by merely maintaining a temperature of at least 70°C, or by disinfecting at lower temperatures, sterilization of the complete battery is very difficult as it is not possible to purify the press water in circulation in this case. Disinfectant requirements for individual factories are discussed and the problem of disinfecting raw juice is considered. Infection in the beet washer is discussed and the addition of disinfectant to the water at 30–35°C found to increase its effect. A number of photomicrographs are given.

[1] *I.S.J.*, 1958, **60**, 369.

Reboiling with a drop in Beet Technological Quality. L. SCHMIDT. *Listy Cukr.*, 1958, **74**, 183–186.—A. MIRCEV's definition of "reboiling number" as the ratio of total weight of massecuite to the weight of 100 pol sugar produced, either as raw or white sugar, is considered the most accurate definition. However, the difficulties of making an accurate determination of the weight of massecuite, owing to varying water content, make it imperative to use the massecuite Brix as a basis for calculation. Data tabulated for the 1953–1957 campaigns show a general increase in the "reboiling number" in Czech factories, with a drop in purity of the thick juices. It is shown that for a unit drop in thick juice purity (over the range 92–95), the reboiling number will increase by 0·11.

* * *

Experience with an R.T. Diffuser in the first Campaign. K. CIZ. *Listy Cukr.*, 1958, **74**, 186–189.—Performance data with graphs are given for an R.T. diffuser put into operation in the 1957 campaign at Cejeticky factory. The average losses for the 1000-tons diffuser were 0·3% on beet with a draught of 108%. Considerable corrosion was experienced, especially when the pH fell below 5·6 (the average throughout the diffuser was 5·7). The temperature rose from 68°C at the head to 72°C and fell to 37°C near the tail end of the drum. pH control was found necessary. The quality of juice and pulp was unsatisfactory.

* * *

The Influence of Calcium Chloride Addition on the Pressing Quality of Pulp and on Juice Quality. D. BECKER. *Zucker*, 1958, **11**, 397–397.—Tests were carried out at Dormagen on the addition of $CaCl_2$ to pulp from tower and battery diffusers. An average of 0·045% on beet was used. The dry solids of pressed pulp from the tower increased by an average of 1·6%, and a drop in pH of 0·3 was recorded, too small a decrease to be responsible for the higher dry solids. The increase in dry solids of pressed pulp from the battery was 0·7%; this reduced effect is attributed to the longer retention time in the battery and to the temperature fluctuations. The pH drop was 0·4 units. The need to increase the concentration of $CaCl_2$ where there is no press or condenser water is mentioned. The ash content of the molasses-Steffen pulp increased by 0·3% on addition of $CaCl_2$, the CaO content of the Steffen pulp on addition being far below that of the dry pulp. No effect on juices or equipment was observed, although it was found that the use of $CaCl_2$ is uneconomical, so that the dry solids must be increased by some other method.

* * *

Infection and Sugar Loss in the Tower Diffuser. W. KRÜGER. *Zucker*, 1958, **11**, 397–399.—See *I.S.J.*, 1957, **59**, 320.

* * *

Cleaning Beet Harvested by Beet Combines. V. A. NOVIKOV, N. M. KICHIGIN and V. S. YATSENKO. *Sakhar. Prom.*, 1958, (8), 12–18.—Experiments were carried out to test the efficiency of three types of cleaning machines, including the Silver beet piler, manufactured by U.C.M.A.S. in Belgium, and previously decribed[1]. Full details of the tests are tabulated and the difficulties of cleaning mechanically harvested beet discussed; mass conversion to this method of harvesting is not advocated at present.

* * *

The Optimal Predefecation Temperature. G. N. MIKHATOVA. *Sakhar. Prom.*, 1958, (8), 29–34.—Tests were made to determine the effect of predefecation on colour formation, settling and filtration properties of juice. Unfiltered 1st carbonation juice was recirculated. When healthy beet was processed, it was found that the juice settled and filtered better after hot predefecation through cold predefecation (at 50–60°C) may be used sucessfully if adequate filtering is available. With deteriorated beet, filtration and settling are better after cold predefecation. The colour of juice treated by cold predefecation is reduced by about 30%, the effect being the same as with active carbon or sulphitation.

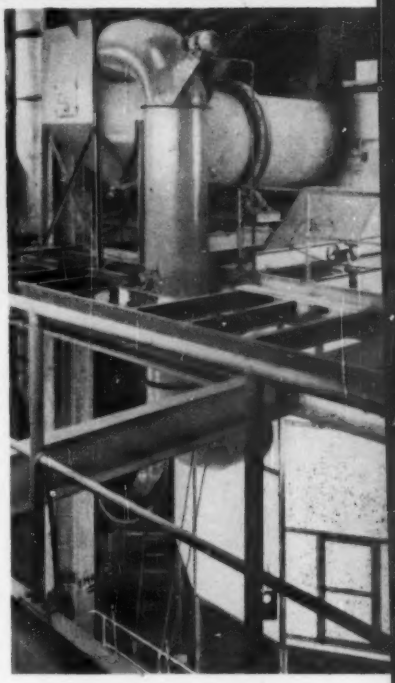
* * *

Simultaneous Processing of Beet and Cane Raw Sugar. M. D. TSERMAN, I. P. FENIK and A. P. BONDARENKO. *Sakhar. Prom.*, 1958, (8), 35–38.—Combined processing of cane raws and beet at the Kreshchatik factory in 1957 was necessitated by the late arrival of the raws and lack of storage space. The most suitable of 3 possible methods is decribed. The raws were melted to a 40°Bx syrup with water from the first carbonation filter-presses and then mixed with raw juice in the proportion of 15% of cane raws on weight of sugar in beet. The composite juice was then processed according to the usual beet factory methods. A three-product boiling scheme was employed in which the C-sugar was double-cured after mingling with A-molasses and was then remelted, passed through bone char, and sent to use in A-massecuite. Some of the run-off was mixed with A-molasses and used for B-massecuite preparation, while some was mixed with A-molasses and B-molasses for the C-massecuite. The A-massecuite was boiled on a mixture of the composite (cane and beet) syrup, C-sugar melt and A-molasses. The viscosity of C-massecuite was lower than with normal beet sugar processing, so increasing the productivity of the C-product centrifugals. Beet throughput increased and the purity of final molasses dropped. White sugar production increased by 12–15%. As a result of the satisfactory results, simultaneous processing of beet and cane raws has been adopted in four other Soviet factories.

* * *

Pre-Defecation. A. CISSOWSKI. *Gaz. Cukr.*, 1958, **60**, 246–250.—Predefecation is discussed on the basis of experience in the Polish factories and a method of cold progressive defecation is described. Tested at Sokolów factory in 1957, the method involves the use of a special lime doser. Juice is progressively limed as it passes through each of seven cells of a mixer, the whole operation lasting 20 minutes.

[1] *I.S.J.*, 1958, **60**, 556.



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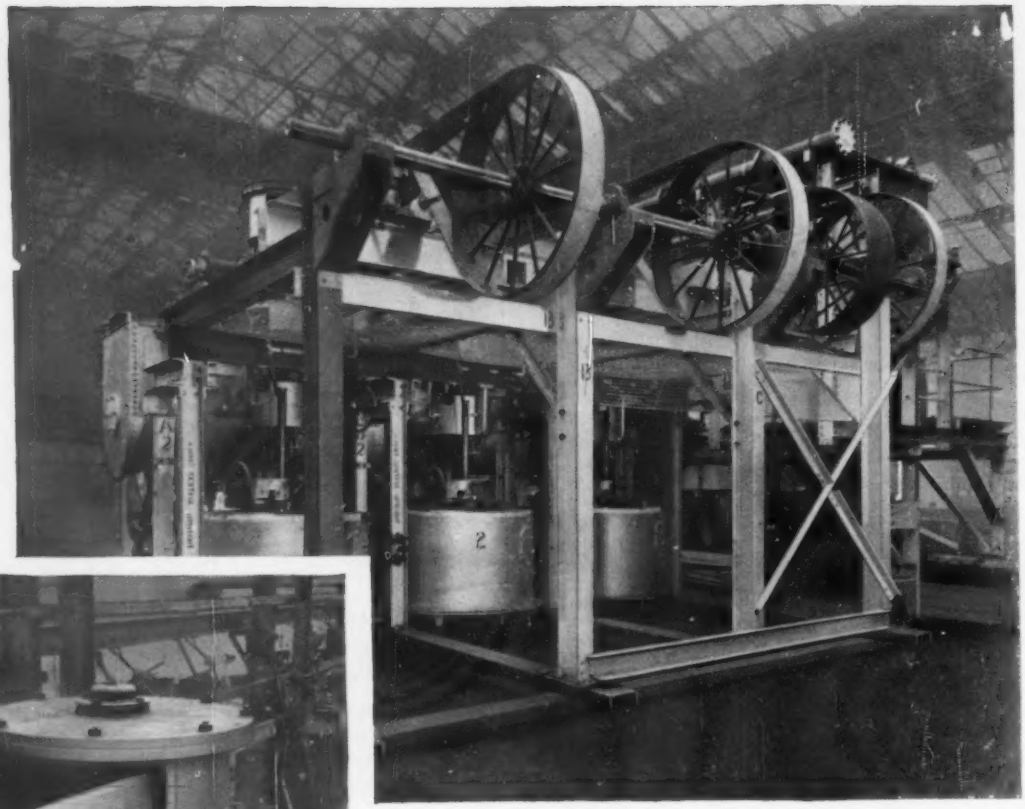

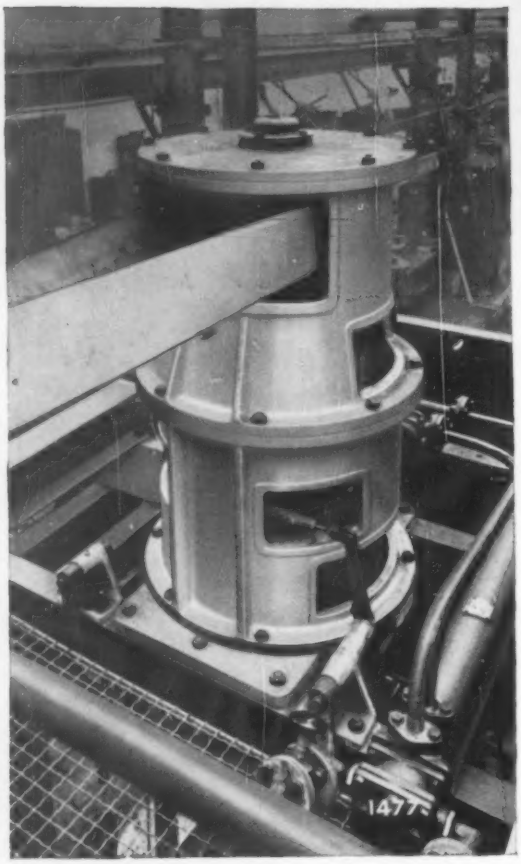

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New Books and Bulletins

Memoria de la XXXI Conferencia Anual de la Asociación de Técnicos Azucareros de Cuba. 294 pp.; 6¾ × 10¼ in. (Asociación de Técnicos Azucareros de Cuba, La Habana, Cuba). 1957. Price : $10.00.

The new volume, recording the 1957 conference of the Cuban Association, follows the same pattern as previously, with lists of the founder-members, ex-Presidents, Consultative Council, patron members, and officers of the Association, obituaries and table of honour. The members attending the 31st Conference, and an index to the papers read, are followed by the text of the papers, and a survey of the work of the Cuban Institute of Scientific Investigations, the report of a meeting of the Cuban sub-committee of ICUMSA, and the announcement of the Association's Committee of Projects and Investigations.

* * *

Reports on the Progress of Applied Chemistry. Vol. XLII. 910 pp ; 5¼ × 8¼ in. (Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.) 1957. Price : £5 0s. 0d. (to non-members).

The sections of applied chemistry covered in this review of the 1957 literature remain the same as in the 1956 edition[1]. The review of the literature on sugar by Dr. A. CARRUTHERS covers degradation, colour formation (with emphasis on the C.I.T.S. conference discussing these) and removal, and analysis, as well as general topics. Thirty references are listed as well as a supplementary bibliography.

* * *

Proceedings of the 15th Annual Convention of the Deccan Sugar Technologists' Association (India), 1958. Part I. 198 pp + 7 pp ; 6¼ × 9¾ in. (Deccan Sugar Technologists' Association (India), Ravalgaon, Dist. Nasik, Bombay, India.) 1958.

Lists are given of the Association's office-bearers, patrons, committee members and other members, honorary, life and companion. The texts are given of the thirty papers read at the Conventions and the appendix deals with the prize plot competition. Field and factory performance data are tabulated for the sugar companies of the region.

* * *

Proceedings of the 9th Congress of The International Society of Sugar Cane Technologists. Vol. II. x + 790 pp ; 6 × 9½ in. (Executive Committee of the I.S.S.C.T., New Delhi, India.) 1956.

The second volume of the Proceedings[2] includes a contents, author index and papers of the engineering, manufacturing, chemical analysis and factory reporting, and by-products sections, as well as the symposia on sugar engineering, cane juice clarification and payment of cane price. Details of the programme of the Congress follow, together with the Presidential Address and reports of the General Secretary-Treasurer and Committees. The minutes of the plenary sessions are noted and the Constitution of the Society reprinted.

* * *

Proceedings of the 1957 Meeting of British West Indies Sugar Technologists. iv + 237 pp ; 8 × 10¾ in. (British West Indies Sugar Association (Inc.), 46 Harbour Street, Myrtle Bank P.O., Kingston, Jamaica, W.I.) 1957.

The Proceedings of the Meeting held in November, 1957 are given in approximately the same form as those of the 1955 Meeting. Included are the lists of Officers of the Conference and of those in attendance, programme, the chaiman's and opening addresses and valedictory speeches. The text of papers covering agriculture, plant pathology, entomology and factory technology are given.

* * *

Proceedings of the 26th Annual Convention of the Sugar Technologists' Association of India, 1958. 204 pp ; 7¼ × 9¾ in. (Sugar Technologists' Association of India, Nawabganj, India, 1958.)

The Proceedings of the Indian Association's 1958 Convention is again in two parts of 90 and 114 pages, respectively, both containing lists of current and past officers, patrons and honorary fellows, followed by the texts of the papers presented, including 14 in Part I and 13 in Part II.

* * *

Atlas des Ennemis et Maladies de la Betterave. (Atlas of the Enemies and Diseases of the Sugar Beet). L. ERNOULD and L. VAN STEYVOORT. 70 pp; 5 × 7¾ in. (Inst. Belge pour l'Amelioration de la Betterave, Tirlemont, Belgium.) 1958.

In its 70 pages, the Atlas covers all the ills which befall the sugar beet, whether caused by insects, nematodes, fungi, mineral deficiencies or excesses, or climate. Grouped according to their appearance on young or older plants with subdivision by root or foliage, each is treated under the heads, symptoms, cause and preventive treatment. Included are 30 full-page coloured photographs.

[1] *I.S.J.*, 1957, **59**, 77.
[2] First volume issued earlier, *see I.S.J.*, 1958, **60**, 272.

Laboratory Methods and Chemical Reports

A Survey of the Work Done in South Africa on the Direct Analysis of Cane Consignments, with Special Emphasis on Recent S.M.R.I. Investigations. K. DOUWES DEKKER. *S. African Sugar J.*, 1958, **42**, 305–309, 573–577.—Investigations on development of a method of direct testing of cane consignments are surveyed, and a method described which, it is hoped, might provide a satisfactory solution. A kick sampler, working on knifed cane just before it falls into the crusher, produces a sample from both sides of the carrier, which should eliminate inaccuracies found when hand sampling one side or other. Direct analysis of the sample by high-speed extraction using the Hawaiian or Australian methods has been found to give results which were higher by about 1·8% than those obtained by analysis of mixed juice and bagasse, but it is nevertheless considered promising.

* * *

Thermal Transformations of Solid Sucrose under the Action of Superheated Steam or Hydrochloric Acid Vapour. P. NAFFA and Y. ANDRE. *Sucr. Franç.*, 1958, **99**, 165–172, 198–205, 229–232.

The literature on sucrose degradation on heating is reviewed ; it is noted that almost all deals with heating above the m.p., and so experiments were carried out on thermal decomposition below 160°C and the reactions with dry steam and HCl vapour at these temperatures. The vapours and steam were passed through sucrose samples (at different mesh sizes) contained in a U-tube, which was held in a thermostatically-controlled bath. The reducing sugars formed were measured by the Saillard method, while the sucrose remaining was found by inverting and determining total reducing sugars by the Bertrand method. Other techniques employed were saccharimetry, paper chromatography, and spectrophotometry.

With dry air at 110°C no change occurred ; at 130°C, powdered sugar was slightly decomposed, with formation of reducing sugars. At 150°C decomposition occurred slowly with formation of reducing sugars, lowering of solution pH and increase in solution resistivity ; this decomposition increased with fineness of the sample and time of heating. Dry steam, with or without air, had but slight effect, 2 hr at 130°C producing 2% decomposition to reducing sugars. Heating for 6 hr at 130°C or 2 hr at 150°C produced an unexplained condensation and subsequent browning of the sugar with formation of reducing sugars. Dry HCl gas caused darkening of the sugar, and liberation of water by decomposition ; the products were a black insoluble solid (carbon and humic substances), and soluble substances giving a dark coloured solution. In the latter were found, *inter alia*, glucose and fructose, an aldehydic fraction, a ketonic fraction and hydroxymethyl furfural. More glucose was left than fructose. The action of variables was examined ; no effect was obtained below 100°C, decomposition took 2 min at 130°C, and at 150°C it was almost instantaneous. The rate of reaction increased with HCl concentration in the vapour/air mixture, and also with the fineness of the sugar. No similar reaction was obtained when the sucrose was replaced by α-methylglucoside, while an analogous change was observed with fructose ; but the yield of hydroxymethyl furfural was increased. The decomposition of sucrose is considered to yield the furfural derivatives, while water liberated leads to inversion of unchanged sucrose.

* * *

A Modification of the von Steiglitz Electrometric Method for Sugar Titrations. L. W. CHUBB and A. W. HARTLEY. *Analyst*, 1958, **83**, 311–312 ; through *S.I.A.*, 1958, **20**, Abs. 456.—The apparatus of VON STEIGLITZ[1], for electrometric end-point determination in the Lane and Eynon titration, requires the use of special electrodes having plaster of Paris plugs ; these plugs have a short life. The pattern of electrode may be replaced by the outer case of a Cambridge pH reference electrode (or one of similar type). Differences between titres obtained by this modified method and by the methylene blue indicator method have never exceeded 0·1 ml in 25 ml with any of the sugars mentioned in the Lane and Eynon tables. Individual working conditions with this apparatus should be standardized with the Lane and Eynon tables.

* * *

Infra-Red Identification of Disaccharides. J. W WHITE, C. R. EDDY, J. PETTY and N. HOBAN. *Anal. Chem.*, 1958, **30**, 506–510 ; through *S.I.A.*, 1958, **20**, Abs. 457.—The technique of making pressed discs of KBr, containing small amounts of the sugar or sugar derivative, was used. Diagrams of the infra-red absorption spectra from 650 to 1500 cm^{-1} are given for nigerose, maltose, isomaltose, cellubiose, gentiobiose, sucrose, turanose, maltulose, leucrose, inulobiose, and their acetates. The spectra are sufficiently different to be used as a means of identification of the sugars. Since the mixtures to be examined can be prepared by freeze drying solutions of very small amounts of the sugars with KBr, preliminary crystallization of the sugar is not necessary for identification. Adequate drying of the samples before pressing is essential.

[1] Cf. BROWNE and ZERBAN : "Sugar Analysis", 3rd Edn. (Wiley, New York), 1941. p.755.

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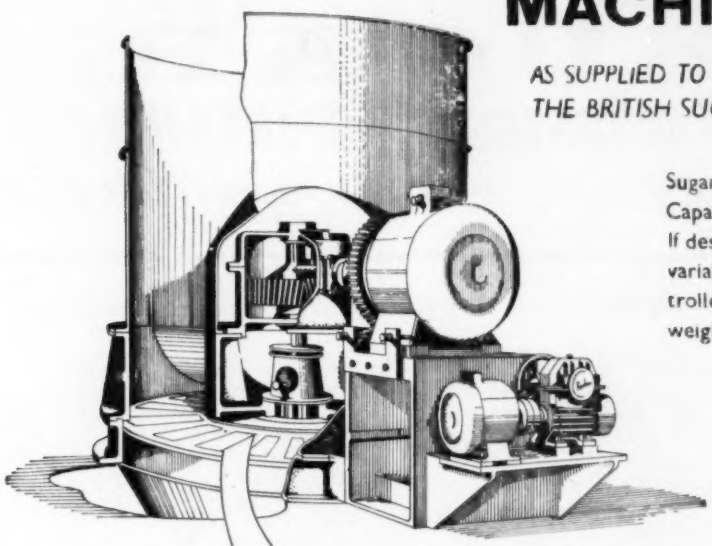

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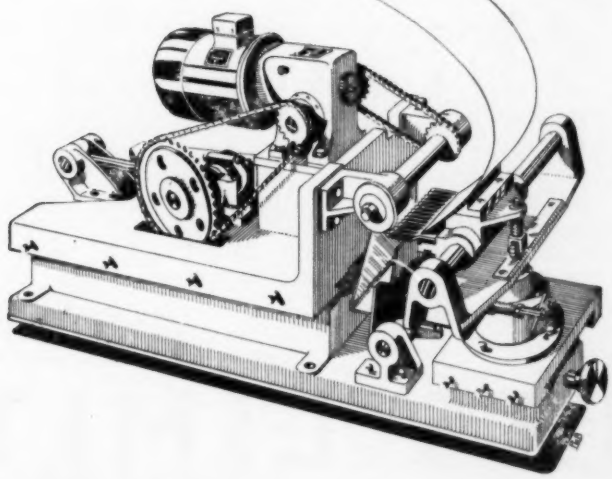

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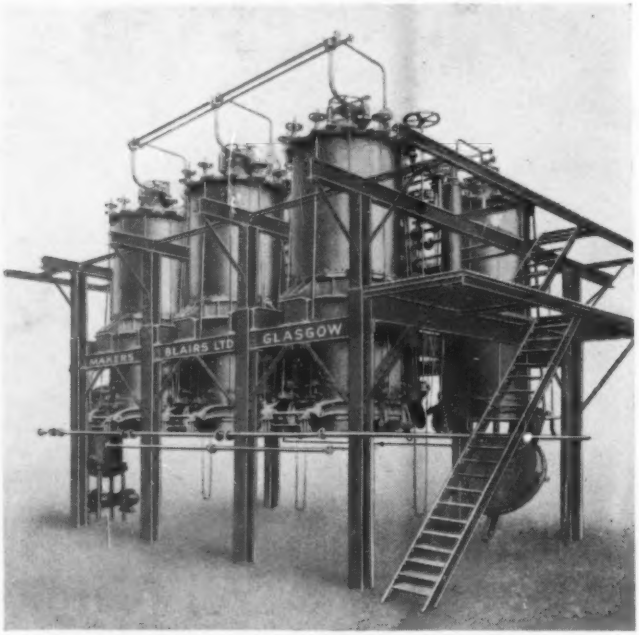

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Browning of Sugar Solutions. I. Effect of pH and Type of Amino Acid in Dilute Sugar Solutions. C. O. WILLITS, J. C. UNDERWOOD, H. G. LENTO, and C. RICCIUTI. *Food Res.*, 1958, **23,** 61–67 ; through *S.I.A.*, 1958, **20,** Abs. 467.—The changes in absorbance at 500 mμ were measured on heating 0·025 *M* glucose solution alone or with varying amounts of of D,L-alanine, L-glutamic acid or L-lysine at varying pH (4 to 9) for 20 min at 114°C in an autoclave. In pure glucose solution, colour developed only at pH > 7, and an alkaline medium was a pre-requisite for significant browning in all cases. The presence of alanine or glutamic acid did not increase the browning. With lysine there was slight extra colour at pH 6 and definitely at pH ⩾ 7 ; this effect was not due to basicity of the lysine, since other basic amino-acids (e.g. arginine, histidine) had no effect. It appears that lysine and alkaline pH have a synergistic effect. Since amino-acids are almost absent in maple syrup, browning of this syrup cannot be connnected with amino-acids.

* * *

Browning of Sugar Solutions. II. Effect of the Position of Amino Group in the Acid Molecule in Dilute Glucose Solutions. H. G. LENTO, J. C. UNDERWOOD and C. O. WILLITS. *Food Res.*, 1958, **23,** 68–71 ; through *S.I.A.*, 1958, **20,** Abs. 468.—The cause of the browning of glucose solutions with lysine (*cf.* preceding abstract) was further investigated by heating solutions of glucose with three series of amino-acids at pH 8 and 114°C for 20 min, measuring the absorbance at 500 mμ. The amino-acid series were (1) 4-, 5- and 6-carbon homologues of lysine with amino-groups on the terminal and α-carbons; (2) and (3) the 3-, 4-, 5- and 6-carbon α-amino, and terminal-amino monocarboxylic acids, respectively. The diamino-acids caused the largest increases in browning (compared with controls of glucose alone), lysine having the greatest effect. Colour formation with mono-amino acids increased from 2- to 4-carbon compounds and decreased again for 5- and 6-carbon acids with terminal amino groups. The α-mono-amino-acids had almost no effect.

* * *

Characterization of Pectic Substances in Fruit and Sugar Beet Marcs. M. GEE, E. A. MCCOMB and R. M. MCCREADY. *Food Res.*, 1958, **23,** 72–75 ; through *J. Sci. Food Agric. Abs.*, 1958, **9,** ii–71.—Fresh plant tissue was extracted with acidified ethanol. Enzymes were inactivated, sugars, soluble organic acids and salts were removed, and the pectinate salts converted into their acids. The insoluble residue was analysed directly without extracting the pectic substances. After corrections for acetyl, determinations of the polygalacturonic acid content by titration and by a colorimetric carbazole method were in agreement. All the carboxyl groups were titrated. The sum of the esterified uronic acid and acetyl carboxyl groups was obtained by direct saponification. The acetyl value was determined by a colorimetric procedure with the ferric hydroxamic acid colour reaction with esters. The total anhydrouronic acid, the acetyl and % of uronic acids esterified were thereby obtained.

* * *

Absence of Carbonate in Beet Molasses. J. B. STARK and H. M. WRIGHT. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9,** 566–567.—Beet molasses analyses have quoted carbonate as being a major inorganic constituent. It would be expected, however, only when insufficient Ca or other suitable cation was present for precipitation, or when the molasses was too acid. Therefore 12 representative molasses samples were analysed for carbonate by treating with sulphuric acid and measuring the pressure of the gas evolved, contacting with NaOH, and measuring the pressure of the residual gases. None of the samples showed more than 0·07% carbonate ; this is the limit of accuracy of the method so that it can be deduced that no carbonate was present.

* * *

Crystallization of Sucrose with Sonic Waves. A. VANHOOK, W. F. RADLE, J. E. BUJAKE and J. J. CASAZZA. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9,** 590–595.—Experiments on sonic irradiation of sterile and isolated syrups indicate that the mechanism of sound activity is heterogeneous and not homogeneous as had been thought. Such treatment accelerates the adjustment of supersaturated syrups, both pure and impure, but has no special effect on the rate of growth of single crystals ; hence, its effect must be almost entirely due to enhanced nucleation by false grain formation. The effect of sonic graining become more pronounced with increasing supersaturation and time of irradiation. A threshold power level of about 2 sonic watts per sq. cm. is necessary to give significant results, energy above this level being relatively ineffective. The optimum frequency is about 10 kc/s. No unusual temperature effects have been noted over the range 30° to 70°C.

* * *

Crystallization of Sucrose. I. Candying from the Point of View of Sucrose Cyrstallization. V. VESELY. *Listy Cukr.*, 1958, **74,** 159–163.—Candying refers to the addition of sucrose to a supersaturated solution, followed by cooling without agitation. The equations of Silin and Truffault for the rate of crystallization are considered and it is shown that the rate of crystallization of sucrose from pure sugar solutions in a state of rest can be expressed as : $R = \frac{\Delta c}{\eta} K$, where R is the amount crystallizing per sq. m. of crystal surface per min, Δc is the difference between the concentration of mother liquor and of the saturated solution at the given temperature ($= K_p - 1$, where K_p is the coefficient of supersaturation), η is the viscosity of the sugar solution and K is a constant, independent of concentration but dependent on temperature. From values of η and Δc, the relation $\eta = Ae^{B\Delta c}$ is derived for a temperature range of 20–40°C, where A and B are constants dependent on

temperature but not concentration. Thus an optimal value of Δc can be found to obtain the maximum rate of crystallization; within the range 0·0–0·5 for Δc this is given by $\Delta c = 1/B$, corresponding to a supersaturation of 1·201 at 20°C or 1·232 at 40°C, which is within the intermediate zone. In practice, the best candying effect was found at a supersaturation of 1·23 at 25°C, falling during 12 hours to 1·17, in the metastable zone. It is pointed out that the optimum value also depends on the size and type of vessel employed.

* * *

Use of an Electrical Heater for the Determination of Invert Sugar by Reduction Methods. J. HAMPL, A. SVOBODA and V. RASPER. *Listy Cukr.*, 1958, **74,** 163.—Electrical heating was compared with gas heating in the Lane & Eynon, Schoorl and Ofner methods of determining invert sugar. The tabulated results show that the differences were no greater than the experimental error and electrical heating is thus recommended.

* * *

Estimation of Reducing Sugars in Cane Juices. K. PARTHASARATHI, S. RAMAKRISHNAN and M. VIJAYASARADHY. *Indian Sugar*, 1958, **8**, 141–142.—The Lane and Eynon method and Vander Plank micromethod of reducing sugar analysis are compared; with solutions of pure sugars the results are comparable, but with cane juices, the former gives lower results. The Vander Plank results proved nearer to check analyses carried out using yeast fermentations and it is considered to be convenient and accurate for routine analyses.

* * *

Sucrose Nitrate. Preparation, Crystallization, Properties. P. LHOSTE. *Mém. Poudres*, 1957, **39,** 191–193; through *S.I.A.*, 1958, **20,** Abs. 553.—Good yields of crystalline sucrose octanitrate have been obtained by adding sucrose gradually to a nitrating mixture (50% HNO_3, 25% acetic acid, 25% acetic anhydride) at 5°C, shaking for 30 min, and pouring into ice water, dissolving the precipitate in methanol and evaporating slowly to crystallization. Some physical and chemical properties were determined.

* * *

Errors in the Determination of Alpha-Amino Acids by the Copper Complex Method. I. G. VAVRINECZ. *Cukoripar*, 1958, **11,** 73–81; through *S.I.A.*, 1958, **20,** Abs. 571. **II.** K. VUKOV. *Cukoripar*, 1958, **11,** 81; through *S.I.A.*, 1958, **20,** Abs. 572.

(I) SLAVÍCKOVA'S method has been further examined[1], using model solutions. In molasses clarification with basic lead acetate, the consumption of the latter depends upon its quality and upon the non-sugars present. The results are also affected by the molasses concentration and pH, so that these must be controlled. Filtration conditions are important, and the first sixth of the filtrate should be discarded. The amount of copper phosphate reagent must be measured exactly, since excess leads to high results. It is considered that the accuracy is only to within 10–20%. This iodometric titration method is tedious and is not considered to have advantages over the quicker and cheaper colorimetric method. The results of various tests are fully tabulated.

(II) VAVRINECZ'S study is considered useful, but, since molasses contains less amino-acids than were present in his model solutions, the effect with regard to sources of error will be less. It is not agreed that the colorimetric method is as good, and a titrimetric method is in principle preferred.

* * *

Dielectric Constants of Aqueous Solutions of Glucose and Sucrose. I. A. SHEKA and A. P. KABAN. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1957, **17,** 179–185; through *S.I.A.*, 1958, **20,** Abs. 577.—The dielectric constants of 20–90% sucrose and 10–95% glucose solutions were measured between 20° and 95°C by the heterodyne beat method at $0{\cdot}966 \times 10^3$ kc/s. For both sugars ϵ decreases with increasing concentration; in unsaturated solutions ϵ decreases with increase of temperature, but in supersaturated solutions it rises to a maximum and then decreases. This effect is attributed to changes in the degree of hydration with temperature. For sucrose, the values range from 75·4 (20% at 20°) to 14·49 (90% at 20°); for glucose from 77·7 (10% at 20°) to 12·5 (95% at 20°).

* * *

Experimental Measurement of the Circulation Rate During the Boiling of Highly Concentrated Sugar Solutions. I. I. SAGAN'. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1957, **17,** 103–107; through *S.I.A.*, 1958, **20,** Abs. 578.—An apparatus for measurements of flow rates of highly concentrated sugar solutions is described. The liquid flows through a ring with tapering sides which is attached to a spring and is displaced along a scale. The design and method of calibration of the instrument are described. Reproducible results are obtained with thick syrups.

* * *

Ash Constituents in Liquor from Service Chars. F. W. SCHWER and R. J. BAIRD. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—Considerable interest has been generated in the composition of ash present in char liquors, particularly since more rapid analytical methods have become available. Using these techniques, it is feasible to evaluate ash removal on a plant scale without excessive effort. The work demonstrates the effectiveness of several service chars (one of which is mainly 100% "Synthad") in removing inorganic constituents from washed sugar liquor.

[1] Cf. *Cukoripar*, 1956, **9**, 49-52; 77-79.

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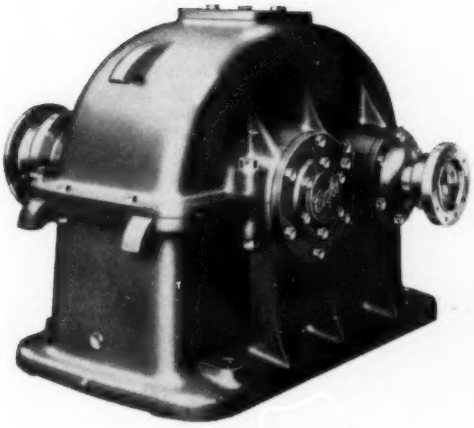

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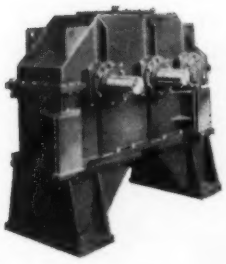

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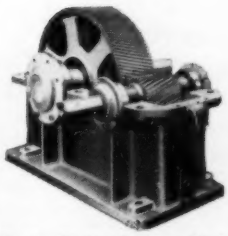

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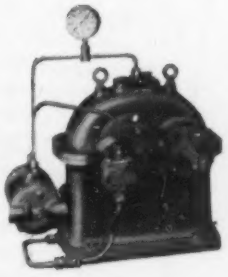

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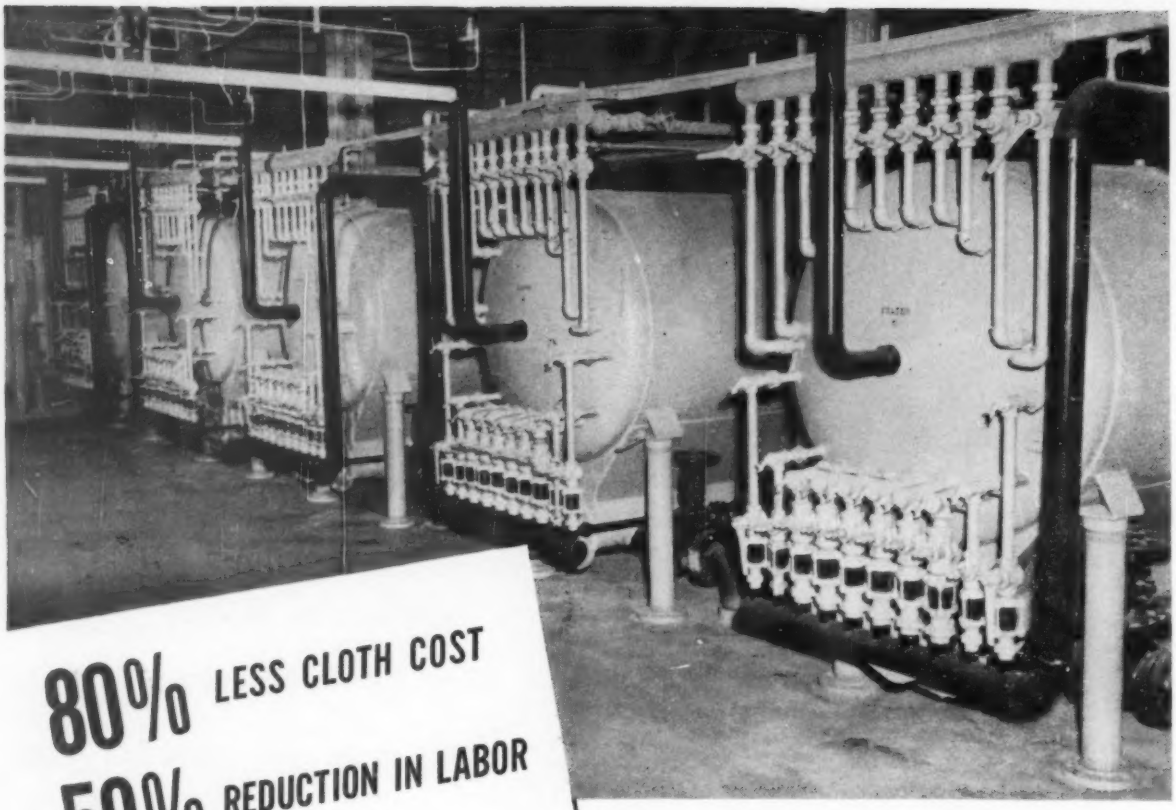

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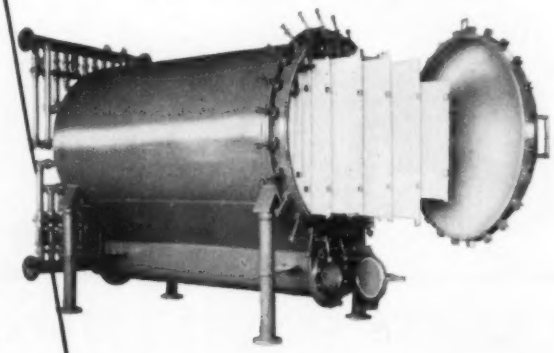

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* * *

Sugar Cane, Atomic Energy and Electricity. E. A. VÁZQUEZ. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 429–435.—Production of electricity by burning cane wastes and conversion of the heat, and by atomic fission of uranium are compared.

* * *

Hydrocarbons and Other Chemical Substances from Sugar Cane and its Derivatives. J. ROMAGOSA CRUSET. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 437–449.—Experiments are described in which bagasse was heated electrically in the presence of catalysts in a retort. Formation of hydrocarbons and other substances constituting bitumen is possible only at temperatures about 400°C and pressures of 1000 p.s.i., and in the presence of catalysts, the yield of bitumen increasing with pressure and temperature. The distillate during formation, and the carbonaceous residue increase with temperature but decrease with increase in pressure. The gases decrease with rise in temperature under pressure. It is considered that Cuba might, in the future, be a source of petroleum chemicals derived from cane by development of the process.

* * *

Improvement of the Aeration System for a Yeast Propagator. H. S. BAH and Y. T. LIU. *Rpt. Taiwan Sugar Expt. Sta.*, 1957, (16), 80–90.—An aeration device includes a stationary air chamber with pores at its upper rim through which passes air. A surrounding turbine propeller rotates so that its blades work the air into a fine emulsion with downcoming fresh liquid medium, and this emulsion is distributed radially at the bottom of the propagation chamber. The oxygen is absorbed as the air bubble rises and the remaining exhausted air is separated by a foam breaking device. The efficiency of oxygenation of a solution of sodium sulphite was measured by a modified Cooper technique[1] and shown to be 100% at a flow rate of 10·027 mM of oxygen per litre per minute. In practical fermentations, 3 hr retention time with a 1:1 per minute air rate using an agitator speed of 1160 r.p.m. resulted in the maximum yeast production capacity of 11·03 g/litre/hr, double the current capacity of Taiwan and other factories using molasses as raw material.

* * *

Paper Pulp from Sugar Cane Bagasse by the Sulphate Process. A. J. ERNST, G. H. NELSON and S. B. KNAPP. *TAPPI*, 1957, **40**, 873–879 ; through *S.I.A.*, 1958, **20**, Abs. 554.—Experimental data on the chemical composition and pulping characteristics of bagasse samples from various sugar-producing areas are tabulated for pulps from : a single batch of separated fibre treated by the sulphate process under a variety of conditions ; separated fibre from cane varieties in several geographical areas using a uniform sulphate pulping treatment ; and whole bagasse and separated fibre using the same uniform sulphate treatment. Chemical compositions of the bagasse and separated fibre, pulping requirements, pulp yields, and bleach requirements alter with variety and location of the bagasse. Digestion with 13% chemicals for 1 hr at 170°C produced good pulps from separated bagasse fibre. Separation of pith and dirt from bagasse is desirable in producing high-quality pulps.

* * *

Pectin Adhesive from Beet Pulp. I. M. LITVAK and M. I. BARABANOV. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1957, **17**, 11–15 ; through *S.I.A.*, 1958, **20**, Abs. 555.—An aqueous suspension of the pulp is hydrolysed with HCl solution at 100°C and the separated hydrolysate is neutralized with 12% ammonium hydroxide solution and filtered ; $AlCl_3$ is added to precipitate the pectin, which is filtered off, pressed, ground and dried. A 4–5% solution of the product in dilute acid is recommended for use as an adhesive in the printing trade.

* * *

Activities of the Sugar Research Foundation Inc. H. B. HASS. *Paper presented to the 17th Ann. Meeting, Sugar Industry Technicians Inc.*, 1958.—The activities of the Sugar Research Foundation are all aimed toward the broad objective of increasing the usefulness of the sugar industry to the people of the world and hence to the expansion of the markets for sucrose and its by-products. To the extent that the by-products can be up-graded they can be made to assume a share of the cost of producing sugar and hence increase profitability or decrease costs. Examples of successful researches by the Foundation are : (1) the work of Professor MRAK and associates on sugar in canned fruit ; (2) the work of R. BOHN on sucrose *versus* dextrose in bread ; (3) the ammoniation of beet pulp ; (4) the sucrose ester detergents ; and (5) the sucrose-phenol-formaldehyde resins. Processes which are still not in commercial production but which look promising are : the reductive aminolysis of sucrose and the conversion of the products to polyamides ; the feeding studies by Professor G. K. DAVIS on the ammoniated bagasse pith and urea-molasses-bagasse mixtures ; and the new work on the allylation of sodium sucrate which resulted in a yield of substantially 100% of theory compared with a previous yield of 50%.

* * *

Fermentation of Beet and Cane Molasses to Butanol-Acetone. K. SCHOEDLER. *Zucker*, 1958, **11**, 399–402.—The fermentation process of molasses to butanol and acetone is described in detail, with a diagram, and the uses of the end-product discussed.

[1] *Ind. Eng. Chem.*, 1944, **36**, 504.

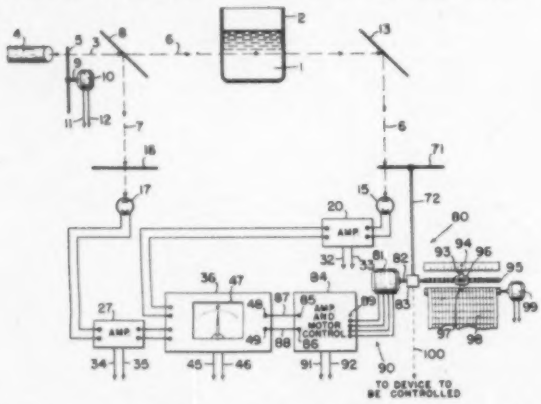
Patents

UTNIED STATES

Treatment of Polyhydric (Sugar) Solutions. N. W. ROSENBERG, assr. IONICS INC., of Cambridge, Mass., U.S.A. **2,860,091.** 22nd September 1955 ; 11th November 1958.—A multichamber electrodialysis unit is used for removal of minor electrolyte components of syrups, beet or cane molasses, etc., where the chambers are separated by permselective ion exchange membranes. The solutions are adjusted to 20–40°Bx (30°Bx) at a temperature between room temperature and 90°C (below 60°C) and passed at a speed greater than 5 cm/sec through the diluting chambers of the unit, through which a direct electric current is passed.

* * *

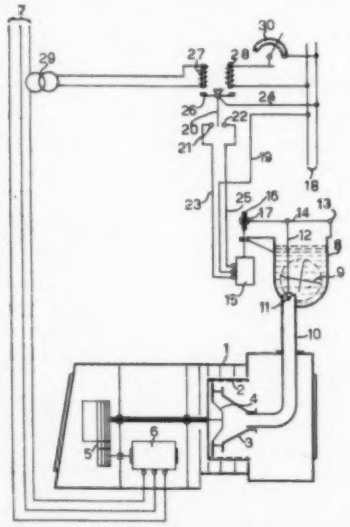
Apparatus for Measuring the Light Rotatory Power of an Optically Active Substance. G. F. LANDEGREN, assr. MINNEAPOLIS-HONEYWELL REGULATOR CO., of Minneapolis, Minn., U.S.A. **2,861,493.** 29th January 1958 ; 25th November 1958.—A parallel beam of monochromatic light from source 4 passes through a polarizing disc 5 and is split into two components 6 and 7 by means of a half-silvered mirror 8. The disc 5 is rotated either by hand or preferably by motor 10 so that the plane of polarization rotates about the beam axis. Consequently, when the beam 7 passes through a stationary polarizing disc 16, the emergent beam is of pulsating intensity and causes a pulsating signal when it falls on photocell 17. When the beam 6 passes through the optically active



solution 1 in container 2, the rotating plane of polarization is advanced or retarded by a fixed amount. Thus, after beam 6 has passed through polarizing disc 71 and photocell 15, a second pulsating signal is produced which has the same frequency as that from photocell 17 but which is separated from it by a phase difference due to the optically active material 1. The signals after passing through amplifiers 20, 27 are fed into a phase meter 36 and the phase differences interpreted in terms of the optical activity of 1. Alternatively, a hand control can be fitted to disc 71 whereby it can be rotated to the null-point where the phase difference disappears, whereupon its position gives a measure of the optical activity of 1. In a third modification as shown, the hand adjustment is replaced by a motor 81 and gearing 83 which rotates disc 71 and also operates the pen-arm 95 of the recorder assembly 93–99. The motor is driven by impulses from the controller 84 which is so designed that it operates the motor so as to eliminate the phase difference impulse sent to it through connectors 87, 88.

* * *

Supply Control for a Push-type Centrifugal. R. SIEGRIST, assr. ESCHER WYSS A.G., of Zurich, Switzerland. **2,868,381.** 2nd July 1956 ; 13th January 1959.—Massecuite or magma in container 8 is kept

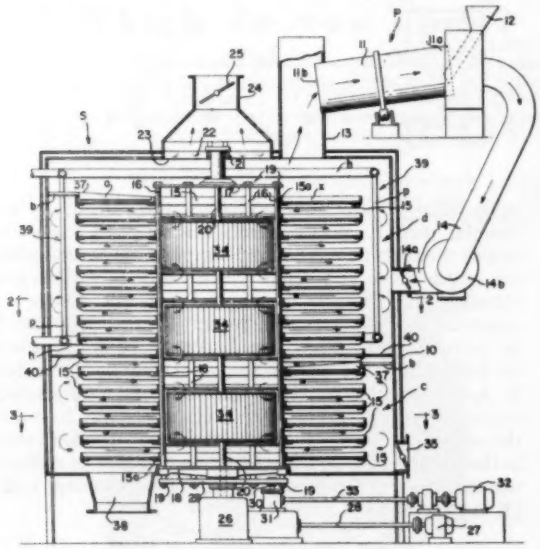


stirred by means of 9 and fed by pipe 10 to the funnel 3 of the push-type centrifugal 1. The basket 2 is driven by electric motor 6 through the belting 5, current being supplied from the mains 7. The passage of material through the pipe 10 is governed by the position of throttle 11 which is mounted on the linkage 12, 14. This linkage pivots about 13 and its position is fixed by the threaded shaft 16 in the nut 17 on the free end of 14. The shaft 16 is driven by reversible motor 15 and rotates to raise or lower the nut 17

(and so throttle 11) according as the arm 20 completes the circuit by making contact with 22 or 21. The position of arm 20 is governed by the balanced state of beam 26 which is attracted by electromagnets 27 and 28. The current for magnet 28 is taken from the mains via rheostat 30, while the current for magnet 27 is derived from the centrifugal drive circuit via transformer 29. The rheostat is set so that, when the amount of material fed to the centrifugal is correct, the attraction of magnet 28 just balances the attraction of magnet 27 and the arm 20 thus does not make contact with either 21 of 22. If the material fed to the centrifugal increases, the load on the motor increases causing the current through transformer 29 to increase. The resulting attraction of magnet 27 is greater than that of magnet 28 so that the beam is pulled over and the motor 15 is energised to close throttle 11 until the load on motor 6 is normal. The reverse takes place when the amount of material entering the centrifugal is too little.

* * *

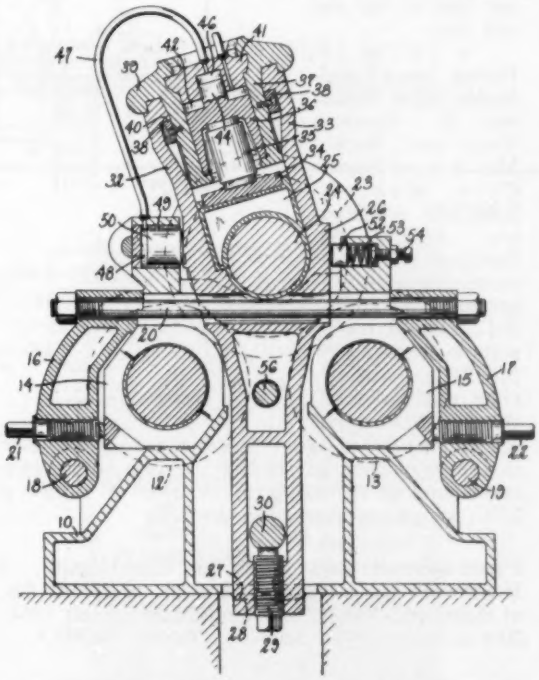
Apparatus for Drying and Simultaneously Cooling White Sugar Coming from a Drier. H. KAMP, assr. BÜTTNER-WERKE A.G., of Krefeld-Uerdingen, Germany. **2,869,249.** 6th December 1955 ; 20th January 1959.—Sugar from the preliminary dryer *P* passes into a tray dryer *S*. The latter houses a series of annular plates 15 held by a circle of vertical rods 16 held at their ends by nuts 19, and so locked to plates 17 and 18. The upper plate 17 is journalled in a bearing 21 supported by spider 22. The rods 16 project downwardly into an internally toothed ring 29 which may be driven by a motor 32 via shaft



33 and gearing 31. Stationary blades 37 are provided for each of the trays 15, which have slots in them, staggered with respect to the slots in the trays below so that, as the trays revolve, sugar is pushed into the tray below, is carried almost completely round this and then pushed through the second slot onto the third tray, and so on, finally discharging through 38. Mounted on a shaft 20 carried by bearing 21 and driven by motor 27 through gearing 26, are a series of fans 34 which cause the air to circulate over the sugar on the trays 15. Cool air enters through the port 35 and cools the sugar in the cooling zone *c* after which it passes into the drying zone *d* above the partition 40. Here it is heated by elements 39 and also mixes with air which circulates through the dryer *P* and is returned through pipe 14 by fan 14*b*. It finally leaves through the stack 24. The amount of total air flow is controlled by valve 25, while the amount passing to the dryer *P* is governed by valve 14*a* such that the sugar entering dryer *S* is sufficiently dry to prevent its caking on the trays. The slow speed of the air leaving *S* is such that sugar dust is not carried off but settles on the trays.

* * *

Cane Mills. P. V. TIPPET, assr. FARREL-BIRMINGHAM CO. INC., of Ansonia, Conn., U.S.A. **2,869,452.** 18th October 1954 ; 20th January 1959.—Feed and



bagasse rollers 12, 13 are mounted in journals 14 and 15 in the side housing of the mill, and held by caps 18, 19 locked together with the throughbolt 20. Lateral adjustment is by screws 21, 22. The necks 24 of top roll 23 are mounted in journal boxes 25 and this is held in a top roll housing 26. This housing projects into the side housings and rests on a surface 28 which is part of the side housing. The contact surfaces 27 and 28 are shouldered to allow the

housing 26 to pivot about 27. The base 27 is drilled and threaded to receive bolt 29 which bears against pin 39 in the side housing, limiting upward movement of housing 26. The top roll journal box 25 is provided with a spacer plate 34, acted upon by ram 36 through block 35. An auxiliary ram 44 is provided in the head 41 of the main cylinder and operates in a cylinder 46, connected by a pipe 47 to a cylinder 48. In this are a liner 49 and a piston 50 acting on the side of the housing 26 ; the action of the piston is resisted by the plunger 52 loaded by spring 53 and having an adjusting screw 54. The cylinder 46, pipe 47 and cylinder 48 form a closed hydraulic circuit so that, as the top roll rises, fluid is directed from 46 through 47 into 48 and so causes the roll to pivot towards the right ; the extent of the movement depends on the relative dimensions of cylinders 46 and 48 and is constant for a constant roll rise. The relative volumes of 46 and 48 are adjusted by altering the size of liner 49 and piston 50 and are so arranged that the ratio of feed to discharge openings does not alter as the top roll rises.

* * *

Drying Non-Crystallizable Sugar Molasses. M. SALCEDO VEGA, assr. SUCRO-MEL S.A., of Mexico City, Mexico. **2,867,535.** 4th January 1957 ; 6th January 1959.—A stabilizing additive is prepared by mixing 8–12 (10) parts of sodium stearate, 45–55 (50) parts of calcium oxide, 4–6 (5) parts of ethanol, and 25–35 (30) parts of water. This is mixed with molasses in the proportion of 20–25 g per unit of molasses corresponding to 1000 g of molasses of 85°Bx at 20°C, and the product spray-dried.

* * *

Power-operated Curb Cover for Centrifugals. J. HERTRICH, assr. WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **2,869,726.** 6th July 1954 ; 20th January 1959.—See U.K. Patent 774,955.[1]

* * *

Scraper Blade Device (For a Centrifugal). F. MORETTI, assr. OFFICINE MECCANICHE E FONDERIE A. BOSCO S.P.A., of Terni, Italy. **2,870,911,** 17th August 1956 ; 27th January 1959.—Cf. U.K. Patent 797,410.[2]

* * *

Crystallizing of Sugars. S. E. KENT, assr. HODAG CHEMICAL CORP., of Chicago, Ill., U.S.A. **2,871,148.** 3rd April 1957 ; 27th January 1959.—Increased recovery, purity of sugar and ease of spinning are obtained by adding 0·01–2·0% (0·3–1·5%) of a fatty acid ester of a glycoside (diester of methyl glycoside), the fatty acid radical containing from 8 to 22 carbon atoms (12–14 carbon atoms).

* * *

Cane Harvester. R. J. LA ROSE and E. P. CLAUSE, of Labadieville, La., U.S.A. **2,871,645.** 23rd November 1954 ; 3rd February 1959.

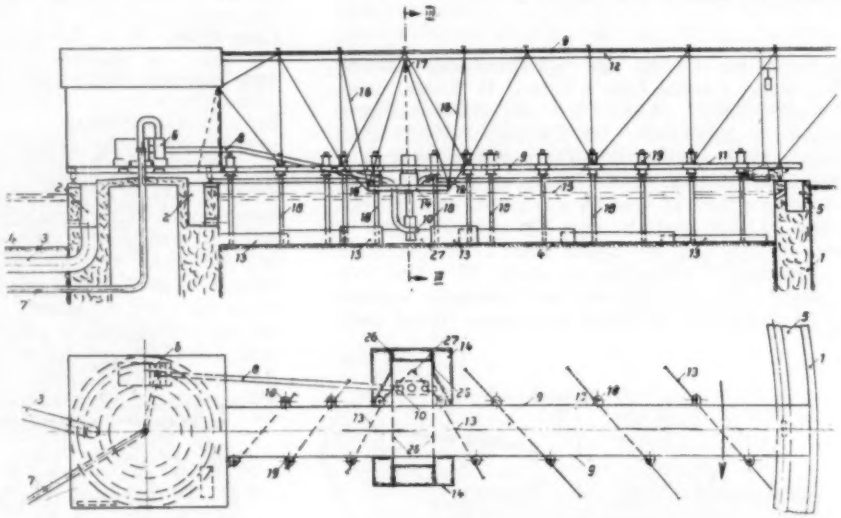
* * *

UNITED KINGDOM

Beet Diffusers. MASCHINENFABRIK BUCKAU R. WOLF A.G., of Grevenbroich, Germany. **807,306.** 24th June, 1955; 14th January 1959.—Cf. U.S.P. 2,816,049[3].

* * *

Clarification Plant for Service and Waste Waters. (Settling Pond for Beet Waste Waters). A. SAMBRAUS, of Lüneberg, Germany. **807,308.** 18th November 1955 ; 14th January 1959.—The settling basin has a



substantially horizontal bottom 4 surrounded by an annular wall 1. Waste waters are supplied from the centre through passage 2 and supply pipe 3, and after the solids have deposited, clear water is discharged through the annular passage 5. Thick sludge is removed by the rockable pump 10 and pipeline 8 to pump 6 and outlet pipe 7. Pump 10 is mounted on trolley 12 which is carried on the rotatable bridge 9. A catwalk 11 is provided for inspection. Suspended matter is pushed by scraper blades 13 to as to enter the range of pump 10, these blades being adjustable in the vertical direction by a system of ropes of pulleys which governs the position of the supporting rods 18 in guides 19.

* * *

Beet Harvester. T. S. JOHNSON, of March, Cambs. **807,848.** 9th May 1957 ; 21st January 1959.

[1] *I.S.J.*, 1957, **59**, 351.
[2] *I.S.J.*, 1958, **60**, 307.
[3] *I.S.J.*, 1958, **60**, 148.

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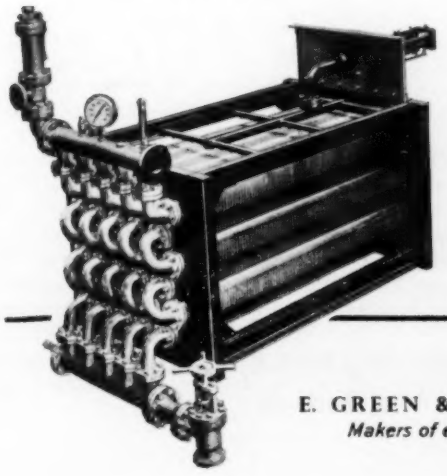

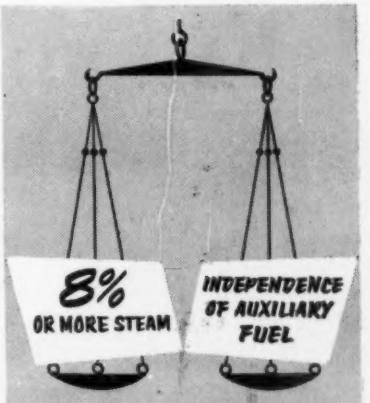

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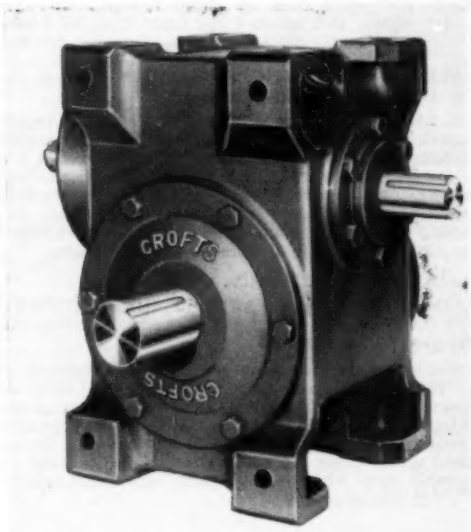
TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

New Gear Units. Crofts (Engineers) Ltd., Bradford 3, Yorkshire.

Two new types of gear units, the Universal Worm Reduction Gear Unit (illustrated) and the Universal Helical Gear Unit, have been announced by Crofts (Engineers) Ltd., Bradford. The primary feature of both units is their adaptability to a wide variety of mounting positions, shaft dispositions and ratios of speed reduction. This is accomplished by a standardised design, basically similar in each case, which employs a single type of gearcase cast with integral feet.



An advantage of the first design is the quick and easy modification from one assembly to another by the simple interchange of oil fillers, drain and level plug positions. No stripping and fitting is necessary. The double extension wormshaft makes either right or left hand assembly possible by simply removing the fan and cowl and replacing them on the opposite end.

The range of sizes initially available have 4 in, 6 in and 8 in centres for powers fractional to 50 horsepower, stock ratios 5 : 1 to 70 : 1. Smaller and larger sizes up to 14 in centres will be available shortly.

The Helical Gear Unit, also by virtue of its standardised design, is adaptable to any installation in any mounting position and for any combination of gears or shaft arrangement.

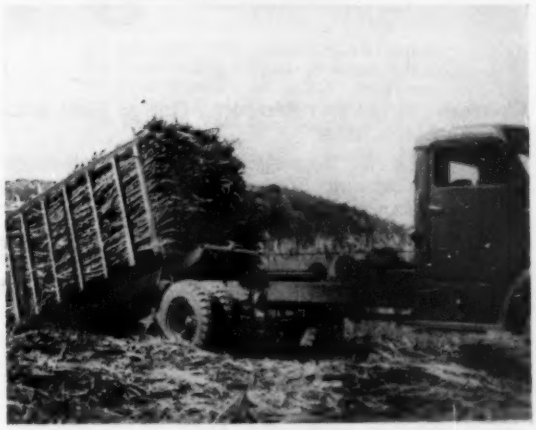
The gears are single helical throughout, standardised to give a wide range of ratios, with single, double or triple reduction gear trains as required, and with parallel input and output shaft dispositions—or available as right angle drives using spiral bevel gears for the first reduction.

A unique feature of this design is that, regardless of the size or combination of gears, the input and output shafts are in the same horizontal plane, and for each size unit are dimensionally in the same disposition to each other, whether utilising single, double or triple reduction gear trains, or arranged as parallel shaft units or as right angle drives. The unit will be available in a wide range of ratios and up to 500 horsepower. Smaller units will be available in motorised form.

* * *

The "Campo" System of Cane Haulage. FWD Corporation, Clintonville, Wisconsin, U.S.A.

With the "Campo" system, a single FWD Corporation truck complete with a special truck bed, six to eight skids and one or two "Campalva" trailers is claimed to transport as much as three ordinary trucks or ten to twelve animal-drawn carts. Cane is loaded in the field onto a skid and the truck brought directly to it ; a cable is attached to the front end of



the skid and locked in place whereupon the skid is winched under the control of the driver in his cab. The front of the skid rises, as shown in the photograph, and is located by self-aligning rollers. Further winching causes the skid to swing gently onto six supporting rollers. A "Campalva" trailer, attached to the back of the truck, has the skid reloaded onto it by unwinding the winch ; when the skid is transferred, the truck can move to another loaded skid and pick this up. On re-attaching the loaded trailer, the double load of cane may be moved off to the factory.

"Invicta" Vibrating Screens. Russell Constructions Ltd., Adam Street, London W.C.2.

The new "Invicta" high-speed sieving and straining equipment measures only 3 ft across the sieve and, running at 3000 r.p.m., has a capacity of nearly 10 tons per hour of powders, or up to 15,000 gallons per hour of liquids. Advantages include interchangeability of parts, ease of cleaning and maintenance, silence and reliability.

* * *

Electronic Strip-Chart Recorder. George Kent Ltd., Luton, Beds.

The Mark 3 "Multelec" high-speed all-mains operating electronic strip-chart indicator-recorder, up to now of special application only, is now available for millivoltage and temperature measurement (in conjunction with a thermo-couple, resistance thermometer or radiation pyrometer). The "Multelec" has a chart-drive unit permitting variation of chart speeds from 1 in/hr to 4 in/min and is available in single or multi-point form, with point-cycle times of 5, 10, or 20 sec, enabling up to 16 variables to be measured and recorded consecutively.

* * *

PUBLICATIONS RECEIVED.

"FLEXIROLL". Fisher & Ludlow Ltd., Bordesley Works, Birmingham 12.

A new brochure describes the "Flexiroll" conveyor idler system for mining and industrial belt conveyors, which comprises a steel shaft of 85–95 tons tensile strength carrying moulded plastic rollers mounted on graphite-impregnated nylon bearings and separated by graphite-impregnated nylon distance pieces, provided with dust seals. At the ends of the roller assembly are graphite-impregnated nylon thrust bearings, and steel trunnions, separated from the end plate of the shaft by trunnion springs which permit the shaft to flex under varying load.

HERRMANN SCREENS. Hein, Lehmann & Co. A.G., P.O. Box 9107, Düsseldorf, Germany.

A new catalogue illustrates and gives detailed specifications of the very wide range of screens and sieves made by the Herrmann Division of Hein, Lehmann & Co. A.G. They include "Rima" (slit) sieves, "Rastex" sieve grate, "Serpa" sieve plates, round-wire "Dovex" sieves, harp sieve bottoms, harp screens, "Vibro" spring-steel wire cloth and mesh, "Rapid" sieves, rubber hole screens, rubber thread screens, "Duo" screens, "Conidure" perforated sheets, metal conveyor belts of many types, and cast-iron pressure jet screens.

* * *

"RITESPEED" MOTORISED CONVEYOR PULLEYS. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire.

The motorised conveyor pulleys described in a new leaflet, Publication 5911, are ideal for portable, mobile and stationary conveyors, installation is simple and they are robustly built for continuous heavy-duty and trouble-free long life. They are of comparatively low weight, and are available with a roller backstop. Powers range from fractional up to 30 h.p., and they are available in any reasonable combination of pulley diameter and width over the range 6–30 in diameter and 15½–64 in width. Belt speeds range from 70 to 500 f.p.m.

* * *

SPRAYING AND DUSTING MACHINERY. Cooper, Pegler & Co. Ltd., Burgess Hill, Sussex.

This latest catalogue covers the entire range of knapsack, pneumatic, hand- and power-operated sprayers, and knapsack, hand bellows and power dusting machines as well as a dust gun, soil injectors and accessories such as nozzles, valves, lances, etc. New equipment for 1959 includes the "Hurricane" knapsack power mistblower and duster; the "Falcon No. 2" pneumatic sprayer, and a complete new range of nozzles and lances including a 15 ft aluminium telescopic lance.

* * *

STANDARDIZATION OF VARIABLE AREA FLOWMETER SCALING. Fischer & Porter Ltd., Salterbeck Trading Estate, Workington, Cumberland.

A new leaflet gives details of eight types of standard glass tube "Flowrators" which between them cover a wide range of flows and are now being marketed with percentage scaled metering tubes plus either a factor tag or a clip-in metal scale to convert the percentage readings to flow values in the users' required units. They are built entirely from standard interchangeable parts which are available separately, permitting easy range changing.

* * *

THE GRUENDLER CANE CRUSHER PROCESS. Gruendler Crusher & Pulverizer Co., 2915 North Market, St. Louis 6, Mo., U.S.A.

A recent compilation of results before and after the installation of a Gruendler shredder is offered in Bulletin No. 10. Data is presented from a mill in Cuba where the crushing rate has increased from 75 to 100 t.c.h. while the sucrose loss in bagasse has fallen from 2·81 to 1·98%. In Hawaii, a mill has increased its grinding rate from less than 40 to 70 t.c.h., with an increase in extraction from 94·91 to 95·75% sucrose, while moisture in bagasse is reduced from 43·98 to 42·47% and sucrose loss from 2·71 to 1·89%. At another mill the cane crushed was raised from 138·42 to 198·74 tons per hour after installation of the Gruendler shredder process, sucrose extraction also increasing from 92·76 to 93·17%, using slightly less imbibition water. Further details and exact data may be obtained on application to the Gruendler Company.

* * *

SMALL POWER WORM REDUCTION GEARS. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire.

A new folder, Publication No. 5826, describes and classifies the small power worm gears, with tables of speeds, ratios and dimensions for 1⅜ and 1⅝ inch centres, and for standard, inverted and vertical type units. Stock ratios are from 5:1 up to 60:1. In addition, a worm gearmotor is available.

Cuban Sugar Exports, 1958[1]

Spanish tons	*Refined Sugar (Raw Value)*	*Raw Sugar*	*Total*	*Total*
	1958			1957
U.S.A.	(*a*)317,065	2,785,500	(*b*)3,102,565	2,681,636
U.S.A. for animal feed (*c*)	—	1,095	1,095	1,667
U.S.A. for re-export	8,652	33,522	42,084	10,237
Total U.S.A.	325,627	2,820,117	3,145,744	2,693,540
Europe :				
U.K.	2,201	470,721	472,922	411,363
Germany (West)	1,878	34,545	36,423	373,197
Germany (East)	—	—	—	6,706
Hungary	10,903	—	10,903	—
Holland	8,723	169,185	177,908	145,283
Italy	618	—	618	8,667
France	—	60,031	60,031	(*d*)96,959
Belgium	—	16,560	16,560	9,532
Portugal	99	—	99	9,679
Greece	58,271	—	58,271	28,802
Jugoslavia	2,336	—	2,336	20,878
Switzerland	—	15,580	15,580	7,482
Vatican City	519	—	519	—
Austria	—	7,698	7,698	10,676
Eire	2,537	30,040	32,577	9,465
Spain	66,569	—	66,569	22,196
Iceland	4,506	—	4,506	3,959
Sweden	—	33,185	33,185	15,388
Malta	2,901	—	2,901	—
U.S.S.R.	—	182,146	182.146	347,673
Total Europe	162,061	1,019,691	1,181,752	1,527,905
Asia and Oceania :				
Japan	554	539,373	539,927	446,281
Jordan	—	—	—	5,275
Ceylon	8,856	27,747	36,603	8,122
Tahiti	—	194	194	323
Syria	—	37,234	37,234	20,541
Israel	—	19,714	19,714	15,786
Guam	—	—	—	127
Iran	—	9,894	9,894	4,687
Iraq	—	17,497	17,497	7,385
Lebanon	—	8,605	8,605	13,750
Pakistan	—	—	—	31,094
Vietnam	3,011	20,308	23,319	—
Korea	—	4,917	4,917	—
China	—	48,604	48,604	—
Hong Kong	528	7,151	7,679	—
Total Asia & Oceania	12,949	741,238	754,187	553,371
Africa :				
Morocco	2,386	149,232	151,618	183,523
Tunisia	5,452	—	5,452	3,007
Canary Islands	—	—	—	7,059
Total Africa	7,838	149,232	157,070	193,589
Canada, Central and S. America :				
Canada	—	184,539	184,539	91,992
Venezuela	8,085	—	8,085	—
Chile	4,110	—	4,110	40,445
Honduras	942	—	942	4,578
Dutch West Indies	1,451	103	1,554	826
Uruguay	—	—	—	31,820
Bermuda	235	—	235	1,311
St. Pierre et Miquelon	145	—	145	47
Bolivia	—	—	—	1,038
Jamaica	—	—	—	211
Colombia	27,080	—	27,080	—
Total	42,048	184,642	226,690	172,268
Grand Total	550,523	4,914,920	5,465,443	5,140,673

(*a*) Includes 1,158 tons Turbinado sugar.
(*b*) Includes 152,918 tons of sugar in Bond.
(*c*) Also exported to U.S.A. as animal feed : refined 12,681 tons, raws 11,784 tons.
(*d*) Includes 3,686 tons Turbinado sugar.

BREVITIES

South Vietnam Sugar Plans[2].—An agreement was signed in Taiwan on the 18th March 1959 providing for the planning and construction of three sugar factories in South Vietnam by Taiwan technicians under American sponsorship.

* * *

Japanese Sugar Imports[3].—Total imports of sugar into Japan during 1958 were 1,222,985 metric tons, tel quel, compared with 1,161,187 tons in 1957. The principal suppliers were Cuba (515,967 tons), Taiwan (310,637 tons), and Australia (145,317 tons), while fairly large amounts were supplied by Dominican Republic, Peru, Ryukyu, and Brazil.

* * *

Brazil Drought[4].—The drought in Northern Brazil which has persisted in some regions for 5 years has become disastrous to the population and economy of the area. Sugar production is 2 million bags below the estimates, and in Pernambuco, the yield of sugar is reduced from 104 kilos to 86 kilos per ton of cane. New drought-resistant cane varieties are to be developed, fertilization is to be improved and cane planters are to be assisted with loans.

Ecuador Factory Plans[5].—Capital is being sought for a sugar factory which is planned. Daily capacity is to be 600 tons of white sugar.

* * *

Khandsari Tax in India[6].—Considerable expansion of the khandsari industry has taken place of recent years, prejudicing the progress of Indian centrifugal sugar production. The tax advantages hitherto allowed to this grade of sugar are therefore to be partly abolished, and the 1959/60 budget provides for a basic excise duty and an additional sales duty to be imposed on khandsari.

[1] C. Czarnikow Ltd., *Sugar Review*, 1959, (396), 48.
[2] C. Czarnikow Ltd., *Sugar Review*, 1959, (400), 65.
[3] C. Czarnikow Ltd., *Sugar Review*, 1959, (397,) 53.
[4] F. O. Licht, *International Sugar Report*, 1959, **90**, (Supp. 5), 70.
[5] F. O. Licht, *International Sugar Report*, 1959, **90**, (Supp. 7), 102.
[6] F. O. Licht, *International Sugar Report*, 1959, **90**, (Supp. 7), 103.

BREVITIES

Sugar Industry of Pakistan.—In our review of the report for the National Planning Board[1], the Company concerned was given as Ford, Bacon Inc. instead of the correct name of Ford, Bacon & Davis Inc.

* * *

New Pakistan Factories[2].—The Pakistan Government has consented to the erection of two further factories at Lyallpur and Tando Mohammed Khan, the productive capacity to be 30,000 tons of sugar per year. They are to be put in operation in 1960.

* * *

French Imports and Exports, 1958[3].—Imports of sugar included 457,669 metric tons, tel quel, corresponding to 433,932 tons, refined value, and also 215 tons of refined sugar. Principal sources of raws were the French Union (321,821 tons), Cuba (65,079 tons) and Brazil (61,999 tons). Exports included 176,588 tons, tel quel, of raws (173,935 tons refined equivalent) and 290,033 tons of refined sugar. Principal destinations were the French Union (173,556 tons raws and 152,851 tons refined), Morocco (49,849 tons refined) and Switzerland (71,523 tons refined).

Stock Exchange Quotations

London Stocks (*at 17th April* 1959)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	17/–
Antigua Sugar Factory (£1)	17/–
Booker Bros. (10s)	29/–
British Sugar Corp. (Ltd. (£1)	20/1½
Caroni Ord. (2s)	4/10½
Caroni 6% Cum. Pref. (£1)	17/3
Distillers Co. Ltd. (6s. 8d units)	25/1½
Gledhow Chaka's Kraal (£1)	66/3
Hulett & Sons (£1)	82/6
Jamaica Sugar Estates Ltd. (5s units)	6/9
Leach's Argentine (10s units)	15/6
Reynolds Bros. (£1)	53/9
St. Kitts (London) Ltd. (£1)	57/–
Ste. Madeleine (Ord.) (£1)	37/–
Sena Sugar Estates (10s)	23/6
Tate & Lyle (£1)	45/9
Tate & Lyle Investments Ltd. (5s)	15/6
Trinidad Sugar (5s stock units)	40/9
United Molasses (10s stock units)	32/9
West Indies Sugar Co. Ltd. (£1)	26/9

New York Stocks (*at 16th April* 1959)

	CLOSING MIDDLE $
American Crystal ($10)	42¼
Amer. Sugar Ref. Co. ($100)	39⅛
Central Aguirre ($5)	21¾
Cuban American ($10)	27¼
Great Western Sugar	26⅛
South P.R. Sugar	26¼
United Fruit Co.	40¾
West Indies Sugar Corp. ($1)	45

Mauritius Sugar Exports, 1958[4].—Mauritius exported 78,443 metric tons of 1957/58 crop sugar to the U.K. during 1958 and also 344,030 tons of 1958/59 crop sugar. In addition she shipped 60,089 tons to Canada, 2286 to Singapore, 1270 to Hong Kong, 8966 to Iran, 9332 to Lebanon, 10,148 to Morocco and 4805 to Malaya, making a total of 519,369 tons in all. Local sales and excluded exports to the Seychelles totalled 24,959 tons.

* * *

Sugar Production in Indonesia in 1958[5].—Details of cane and sugar production during the 1958 milling season have been released and are reproduced below, with corresponding figures for the 1957 season.

Estates Sugar Cane.	1958	1957
Gross area harvested (hectares)	52,627·7	52,265·1
Gross yield of cane per hectare (metric tons)	103·7	521·4
Tons sugar per 100 tons cane	10·68	11·46
Gross sugar yield per hectare (metric tons)	11·07	12·77
Small growers' cane.		
Gross area harvested (hectares)	76,388·6	71,460·7
Gross yield of cane per hectare (metric tons)	90·8	98·2
Tons sugar per 100 tons cane	10·57	11·40
Gross sugar yield per hectare (metric tons)	9·60	11·19
Total sugar production (metric tons)	737,076	799,881

Generally speaking, the area harvested includes plant cane plus first and second ratoons. The total area harvested includes third ratoons which, apart from some other minor influences, accounts for the difference between the sum of the 1958 figures for estate cane plus small growers' cane (74,311·9 hectares) and the total given by the Proefstation (76,388·6 hectares).

* * *

The late G. L. Fawcett.—George L. Fawcett, who died recently in Buenos Aires, was born in Nebraska and graduated from the University of that State in 1905. In 1905–1906 he was Professor of Botany in Doane College, and in 1906–1908 Plant Pathologist of the Federal Sub-tropical Laboratory of Miami, Florida. From 1908 to 1915 he was Plant Pathologist of the Puerto Rico Agricultural Experiment Station. In 1915 he was contracted by the Government of Tucumán, Argentine, as Botanist and Plant Pathologist of the Tucumán Experiment Station, which position he held until he resigned in 1947. After that he was honorary plant pathologist to the Tucumán sugar companies until 1954. Besides working in the Experiment Station, in 1916–1918 he was Professor of Plant Pathology in the University of Tucumán. Mr. Fawcett was the first plant pathologist to work in the Argentine, and his work was considered as of very great value to the farmers in the whole of the North of that country. He studied especially the diseases of sugar cane (notably mosaic, smut, top-rot, root disease, black rot and sooty mould), rice, sugar beets, tobacco, cotton, tomato, potato, and citrus. In his botanical work, he carried out very important studies on the identification of varieties of cane, and also formed a complete herbarium of the flora of all the northern provinces, all the specimens being mounted in the same way as those of the great museums of North America and Europe. In the field of plant breeding he produced many important hybrids of tobacco, cotton, tomato, and especially of the sugar cane, the well-known "Tucumán seedling varieties" having been produced by him. A number of these canes turned out to be so superior to the varieties formerly planted, that they now form the principal bases of the Argentine sugar industry, occupying some 260,000 hectares.

W. E. Cross.

[1] *I.S.J.*, 1959, **61**, 56.
[2] F. O. Licht, *International Sugar Report*, 1959, **90**, (Supp. 7), 103.
[3] *Sucr. Franç.*, 1959, **100**, 92.
[4] *Mauritius Sugar News Bull.*, 1959, (88).
[5] *Circular Proefsta. v.d. Java-Suikerind.*, 1959, (1), 5.

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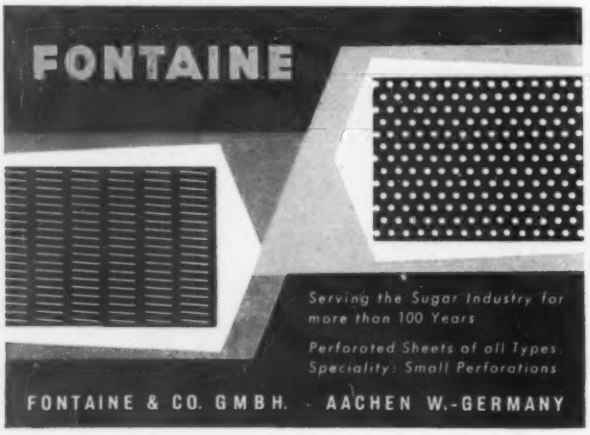
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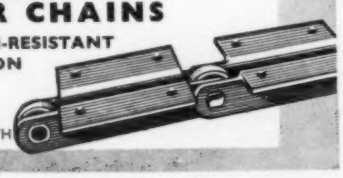

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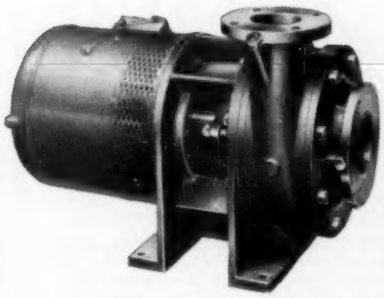

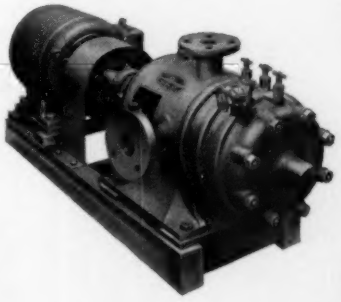

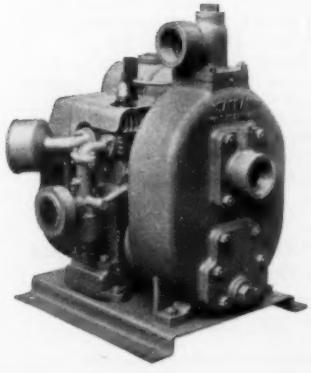

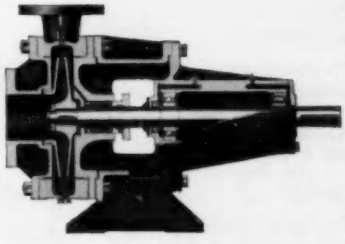

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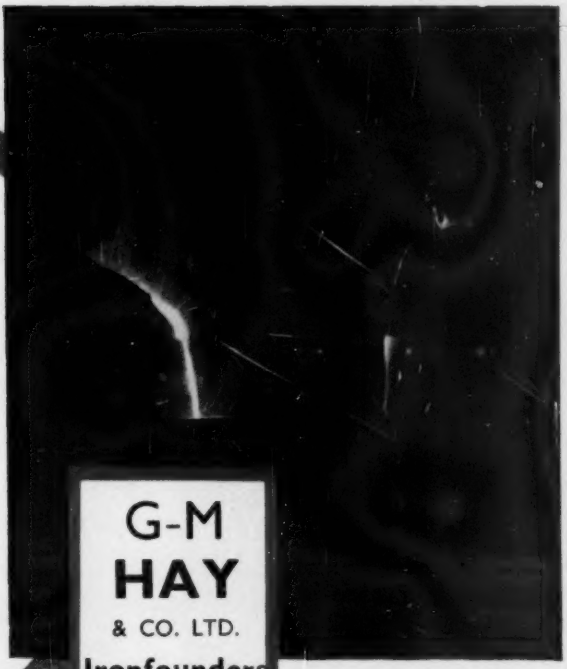

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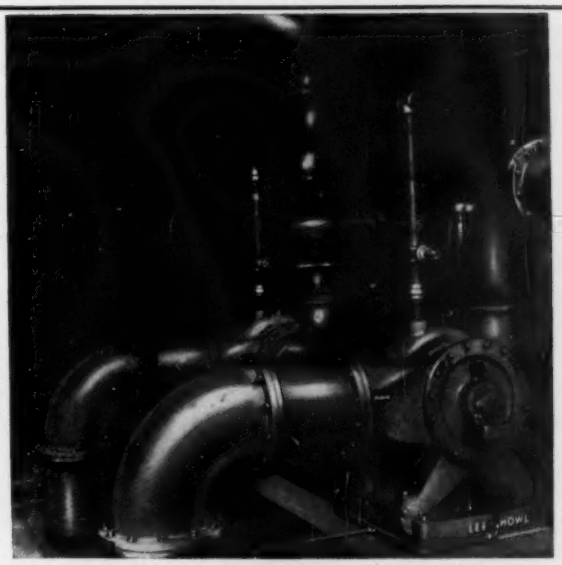

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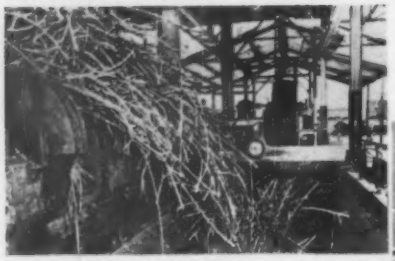

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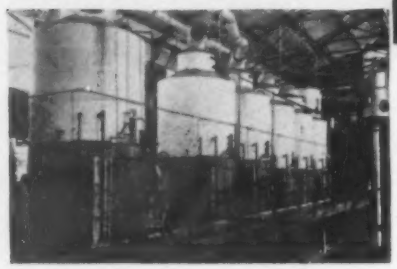

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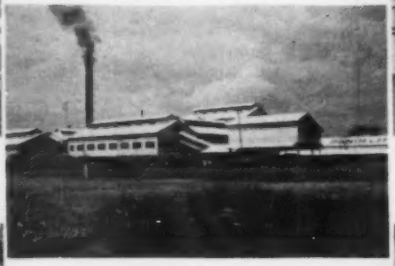

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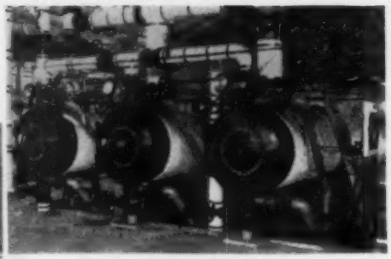

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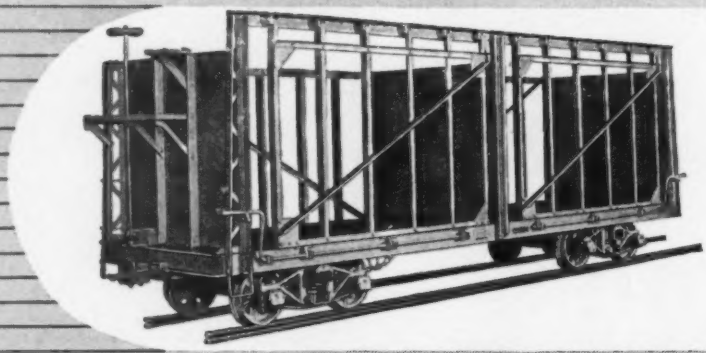

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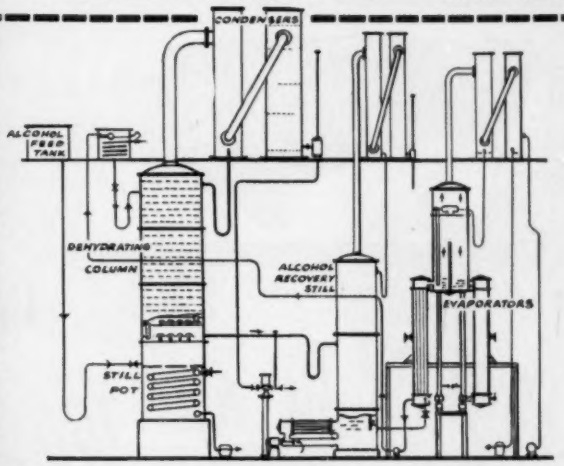

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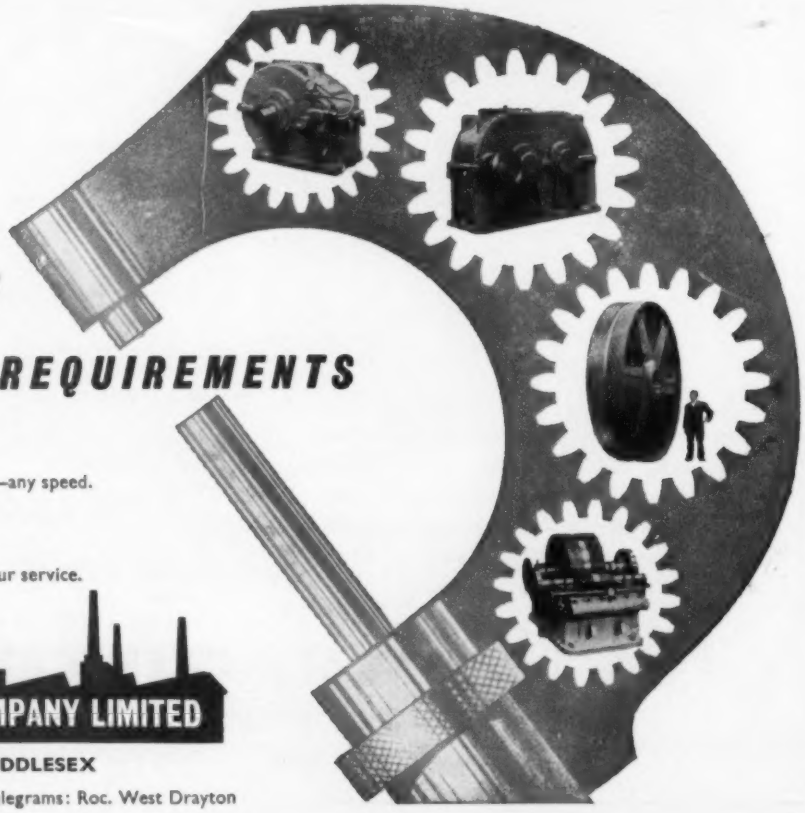

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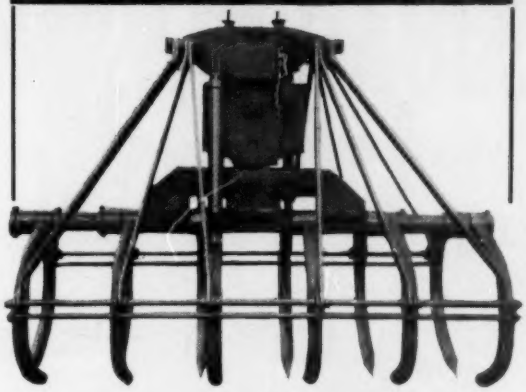

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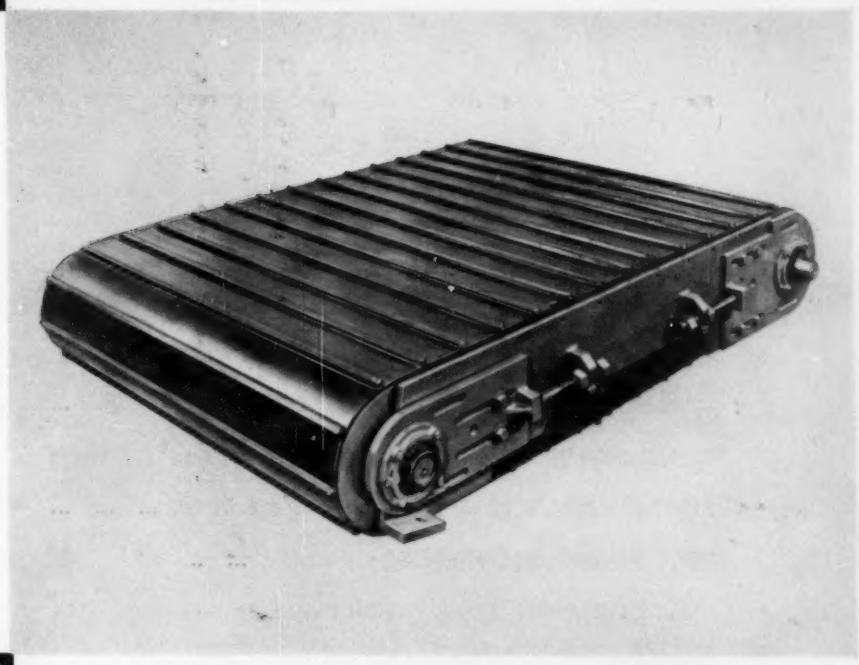

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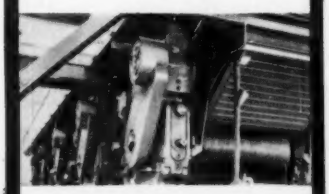

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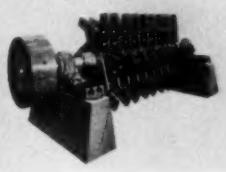

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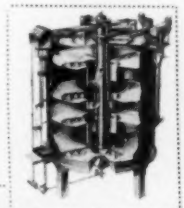

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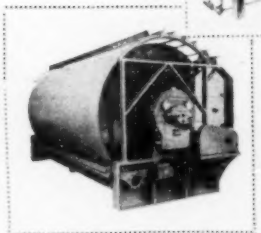

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